U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS.

A DIGEST

OF

METABOLISM EXPERIMENTS

IN WHICH THE BALANCE OF INCOME AND OUTGO WAS DETERMINED.

BY

W. O. ATWATER, Ph. D.,

AND

C. F. LANGWORTHY, Ph. D.

Prepared under the supervision of A. C. True, Ph. D., Director of the Office of Experiment Stations.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., October 29, 1898.

SIR: I have the honor to submit herewith a revised edition of bulletin No. 45 of this office. This bulletin treats of the metabolism of man and the domestic animals, and was prepared by W. O. Atwater, Ph. D., special agent in charge of nutrition investigations, and C. F. Langworthy, Ph. D., editor of the department of foods and animal production of the Experiment Station Record, under the general supervision of the Director of this Office. The bulletin is a digest of about 3,600 experiments in which the balance of one or more of the factors of income and outgo was determined. This compilation is in a sense supplementary to Bulletin No. 21 of this Office on the Methods and Results of Investigations of the Chemistry and Economy of Food. At the outset of the nutrition investigations by this Department the need of compilations and summaries of the widely scattered investigations in this line carried on at home and abroad was fully recognized. Bulletin No. 21 was the first attempt to meet this need. Even before that was completed the plan for the present bulletin was formed by Prof. Atwater and Dr. Langworthy. The collection of material on metabolism was for some time pursued in connection with the nutrition investigations in progress at Middletown, Conn. It soon appeared that it would be unwise to segregate the metabolism experiments with men from those with domestic animals even for the purposes of the nutrition investigations of the Department. Moreover, a review of the experiments with animals was needed in connection with the work of the agricultural experiment stations in the establishment of a scientific basis for the feeding of live stock on the farm. In view of the larger scopethus given to the work, Dr. Langworthy came to Washington, and has since executed the details of this work here, retaining, however, the advice and assistance of Professor Atwater. The library of Professor Atwater contains one of the largest private collections of works on the subject of metabolism. In addition, liberal use has been made of the unusually complete collection of medical and other works bearing on this subject in the library of the Surgeon-General's Office.

As the compilation progressed, records were constantly found of investigations not referred to in general treatises or standard abstract

journals. This was particularly true of reports of investigations made in Russia. Valuable service in collating and abstracting Russian publications has been rendered by Dr. Peter Fireman, of the Columbian University, who is a native of Russia and conversant with scientific publications in that language.

The number of experiments collated far exceeds what was anticipated when the work was undertaken. While the authors do not claim to have found all the investigations ever reported, it seems most probable that comparatively few have escaped their attention.

Advantage is taken of a reprint to make a few minor corrections in the tables.

Respectfully,

A. C. TRUE,
Director.

HON. JAMES WILSON,
Secretary of Agriculture.

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A DIGEST OF METABOLISM EXPERIMENTS.

INTRODUCTION.

GENERAL AND HISTORICAL STATEMENTS.

The animal organism requires food for a twofold purpose, (1) to furnish material for the building and repair of tissue, and (2) to supply fuel for the production of heat and energy. In serving as fuel food protects the material of the body from consumption.

The food of animals consists of the so-called nutrients—protein, fat, and carbohydrates, various mineral salts, and water. Similar compounds and many others are found in the animal body. The oxygen of the air, though not strictly a food, is also essential. All of these substances in both the food and the body are made up primarily of the elements carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, chlorin, silicon, fluorin, potassium, calcium, magnesium, sodium, and iron. The changes which these substances undergo in the multiform cleavages and syntheses involved in the processes of digestion, assimilation, respiration, and excretion are extremely varied.

Tissue is added to the young organism until growth is completed. In the performance of the bodily functions, in the wear and tear to which the organism is subjected, tissue is constantly broken down and consumed and new material is as constantly formed to take its place. Tissue is also formed for the storage of reserve material, but to a less extent and mainly in the form of fat, which serves as fuel for yielding energy. The bulk of the fat in the body is therefore to be considered not as an essential part of the animal machine, but as fuel stored up in it.

Energy is required for the maintenance of the heat of the body and for the performance of its mechanical work. The potential energy of both the nitrogenous and nonnitrogenous ingredients of food and body, i. e., of protein, fats, carbohydrates, etc., is transformed into kinetic energy and used in the body. But this service as fuel is performed chiefly by the fats and carbohydrates, the carbonaceous as distinguished from the nitrogenous nutrients. When burned in the body the nutrients yield energy in the form of either heat or muscular power. Part of this potential energy becomes kinetic in the cleavage of complex compounds to simpler ones; part is liberated in the processes of oxidation. Neither the chemical nor the physical changes which take place

are now fully understood. This much, however, is certain: The processes are complex, and although the ultimate chemical products may be the same as those of direct oxidation, the processes by which they are formed in the body are much more complex than those which take place when they are burned either in the furnace or the calorimeter. But it is believed that, in accordance with the principle of the conservation of energy, the quantity of potential energy which is transformed into kinetic energy will be the same in the one case as in the other, provided the final products are the same. Furthermore, in accordance with the principle of maximum work the tendency is toward those changes which result in the greatest evolution of heat or other form of kinetic energy. Therefore the heats of combustion of the nutrients of the food may be taken as equivalent to their potential energy, i. e., their value for the production of heat and muscular work when they are burned in the body. The same principle applies to the materials, mainly protein and fats, which the body takes from the food and makes a part of its tissue before they are burned. It applies also, in so far as their potential energy is concerned, to the incompletely oxidized excretory products like urea and to the undigested residue of the food and other material which is excreted by the intestines.

All these manifold changes of matter and energy are covered by the term metabolism. It signifies the transformation of matter and energy in the animal organism. Generally speaking, all the material which has undergone metabolism is excreted in the urine and respiratory products, although the feces contain metabolic products along with the undigested residue of food consumed.

One of the usual ways of expressing the results of experiments in metabolism is in the form of a balance of income and outgo. In order to establish the metabolic balance of matter it is necessary to measure the total income in the food and outgo in the excretory products. In practice it is usual to express the balance of matter in terms of nitrogen or nitrogen and carbon, since these are the elements which can be most readily determined and in addition they are the most important and characteristic elements of the materials making up the income and outgo. To establish a balance of energy, which may be best expressed in terms of heat, it is necessary to know the thermal value of all the food consumed and of all the excretory products, as well as the total energy manifested by the organism during the experiment, either as heat or in the form of external muscular work.

The above statement is, however, incomplete in that it does not take into account the material which the body gains or loses during the experiment and the corresponding energy stored or transformed. This material consists mainly of water, protein compounds, and fats, with smaller amounts of carbohydrates and other compounds.

The science of nutrition therefore must be studied from the standpoints of the metabolism of matter and energy if its fundamental laws

are to be thoroughly learned. The ideal experiment for the determination of metabolic balance would include a respiration experiment, a dietary study, and a digestion experiment in which the thermal values, of food and excreta are determined. It would also include a measurement, with a calorimeter, or by other suitable means, of heat produced by the organism. If work is performed it must also be measured. No experiment has yet been made which reaches this ideal. More often special problems connected with metabolism have been the subject of investigation, such as the following: The functions of the nutrients of food; the formation of fat from protein and from carbohydrates; the digestibility of food of various kinds; the isodynamic values of nutrients; the fuel value (potential energy) of food; the influence on metabolism of various diseases, of alcohol, drugs, condiments, and the like, and of various forms of treatment, medical or otherwise, as for instance hot baths; the influence of prolonged hunger or thirst on metabolism; and the quantities of nutrients consumed and appropriate for people of different classes, occupations, and conditions, and for animals of different kinds or animals fed for different economic purposes.

While the ultimate purpose of many experiments in metabolism is to obtain answers to such questions as those enumerated above, in the expression of results the balance of income and outgo is recognized as of the utmost importance.

Before the day of modern science very curious views of metabolism were entertained. The fact was very early recognized that in the urine, feces, and respiratory products substances were eliminated which the organism could no longer utilize and which, if retained, would prove harmful. The nature of the excretory products was, however, not at all understood. Experiments were made in which the food and excreta were weighed and the fact was noticed that although large quantities of food were consumed in a given time the organism did not materially change in weight.

The idea that food is to the body what fuel is to the fire was advanced as early as the seventeenth century. In 1668 John Mayow[1] found that from saltpeter a substance could be obtained identical with one of the constituents of the air, which rendered combustion and respiration possible. This substance was thought to enter the blood and there set up a fermentation which produced heat. He further found that this substance, together with a supply of combustible material, was necessary for muscular work.

These ideas, so nearly resembling the modern views of the subject, were, however, passed over and apparently forgotten.

In 1762 Haller[2] announced a mechanical theory of metabolism. He believed that the muscular movements made by the organism caused

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[1] John Mayow, Opera omnia, 1681; cited by Voit in Hermann's Handbuch, VI, p. 266.

[2] A. v. Haller, Elementa Physiologica, VIII; cited by Voit in Hermann's Handbuch der Physiologie, VI, p. 266.

both the liquid and solid substances composing it to rub against each other until they were worn out and divided into minute particles. The liquid particles were then eliminated in the urine, through the lungs, skin, etc., and the solid matter was eliminated in the feces. The loss of material was made good by the food consumed. This and other mechanical theories were entertained for many years.

The fact that the body loses considerable material through the skin and lungs was very early recognized. In 1614 Sanctorius[1] measured the amount of material thus excreted in a large number of cases in health and disease. His method was as follows: The subject was weighed at the beginning of the experimental period, and from the weight of the body plus the weight of the food and drink consumed was subtracted the weight of the body at the end of the period plus the weight of the urine and feces excreted. He recognized the fact that the insensible perspiration includes the respiratory products as well as the material excreted through the skin.

In the translation of Sanctorius's Aphorisms early in the eighteenth century, Quincy[2] emphasized the fact that the body is a machine and the principles of mechanical motion can be applied to it.

Toward the close of the eighteenth century oxygen was discovered by Priestly and Lavoisier. The latter[3] explained the process of combustion. In 1789 he enunciated the doctrine that combustion takes place in an analogous way in the animal organism.[4] Many physiologists would not accept his views at first. Evidence accumulated, however, and the truth of Lavoisier's opinions was at last generally conceded.

The growth of the knowledge of metabolism owes very much to Liebig. He isolated, analyzed, and studied many of the compounds which occur in food and the various tissues and liquids of the animal organism and made important contributions to the subject of the origin of animal heat and other physiological questions. In this subject, as in many others, Liebig seems to have arrived as if by intuition at conclusions which the labor of later years has only verified.

The early experiments in which the attempt was made to determine a balance of matter are few in number. The subject has been developed largely since 1850.

Of experiments with man the earliest which is included in the present compilation was made by Lehmann[5] in 1839. The methods of analysis

[1]Sanctorius: De Statica Medicina, Leipsic, 1614. Medicina Statica, or Rules of Health. Translated by J. D., London, 1676. Biographie Universelle. Paris: L. G. Michaud, 1825, pp. 308–310.

[2]Sanctorius: Medicina Statica. Translated by John Quincy. London: Wm. Newton, 1712, p. LXVIII.

[3]Lavoisier's Chemistry, Kerr's translation. New York, 1806, p. 63.

[4]Mém. de l'acad. des Sciences, 1789, p. 185. Oeuvres de Lavoisier, II, p. 688; cited by Voit in Hermann's Handbuch der Physiologie, VI, p. 266.

[5]Jour. prakt. Chem., 27, p. 257.

which were then in use render the work of little value except from an historical standpoint.

In 1840 Liebig[1] published a dietary study in which an attempt was made to estimate the carbon balance. The time was one month, and the average number of persons 144. The subjects were a company of soldiers of the bodyguard of the Grand Duke of Hesse-Darmstadt. The amount of each of the food materials is recorded, as well as the computed average per man per day. Elementary analyses of each article of food were made, though many are not recorded. The carbon in the urine and feces was computed. So many details were omitted in the publication of this interesting experiment that it is not possible to make a comparison of it with more modern work.

An extended series of observations was made by Barral[2] in 1847–48. He quotes at length the opinions regarding nutrition entertained at that time. Little is said, however, of the methods he himself followed in his experiments. This is to be regretted, as he attempted to determine or calculate the balance of carbon, nitrogen, oxygen, hydrogen, and mineral matter.

Much of this early work is very incomplete, and numerous inconsistencies in it are now apparent. It was impossible for these early investigators to arrive at more accurate results with the facilities at their command.

From 1850 to 1870 considerably more work was done on the metabolism of animals than of man. About 1860 Pettenkofer perfected his respiration apparatus.[3] This furnished a much better means of investigating the respiratory products than any before used. It differed in several essential points from the respiration apparatus which Regnault and Reiset[4] used in their experiments with animals in 1856, or the still earlier form used by Boussingault[5] from 1839 to 1844. In 1862 Ranke made a considerable number of experiments with man with the Pettenkofer apparatus, and in 1865–66 Pettenkofer and Voit[6] published the results of their experiments, which have been regarded as classic.

Some of the most important work in recent years on the metabolism of man has been done by the Munich physiological chemists, Pettenkofer, and more especially Voit, and later their followers, including Ranke and Rubner, by Pflüger and his associates in Bonn, and by Tchudnovski, Pashutin, Danilevski, Likhachev, and others in St. Petersburg.

The Russian work on this subject is very extensive and of a very high order. However, it has unfortunately been very little known outside

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[1] Liebig's Complete Works on Chemistry. Philadelphia: Peterson. Animal Chemistry, p. 84.

[2] Ann. Chim. et Phys., ser. 3, 25, p. 130.

[3] Liebig's Annalen, Supplement II, 1862–63, p. 17.

[4] Ann. Chim. et Phys., ser. 3, 26, p. 310; Compt. Rend. (56), 1863, pp. 569, 605.

[5] Ann. Chim. et Phys., ser. 3, 11, p. 441; 14, p. 443; ser. 2, 71, p. 127.

[6] Ztschr. Biol., 2 (1866), p. 480; 3 (1867), p. 384; 5 (1869), p. 322.

of Russia. Generally speaking, the analytical details of the experiments have been very carefully worked out, little being assumed from calculation. The work covers a great variety of topics. Most of it has been published as inaugural dissertations for the doctor's degree.

Von Noorden, of Berlin and later of Frankfort, and his pupils have in recent years contributed considerable important work on the metabolism of man. Investigations have also been made by Malfatti, Albertoni, and Novi in Italy; by Kellner, Mori, Oi, and others in Japan; by Paton and North in England, and by Tigerstedt and associates in Sweden. In America considerable matter has been published by Chittenden and his pupils from the physiological laboratory of Yale University. Among the earliest American experiments were those made by Flint with a professional pedestrian in 1873. Some work has also been done by the experiment stations in connection with feeding and digestion experiments with animals. Investigations with man have been and are now being carried on by Atwater and his associates under the direction of this Department.

Experiments on the metabolism of animals have been numerous. Among the earlier investigators may be mentioned Boussingault, Regnault and Reiset, and Bidder and Schmidt. Voit, either alone or associated with Bischoff and Pettenkofer, made a large number of experiments with dogs, between the years 1856 and 1865. Rubner and other pupils of Voit have continued the work, at Munich and elsewhere. The work of Seegen and Nowak and others at Vienna, including Soxhlet and Meissl, has contributed much to the subject. This line of inquiry has also been greatly furthered by the work of Weiske and Flechsig in Göttingen and, later, in Proskau and Breslau; of Wolff, Kellner, and Kreuzhage in Hohenheim; of Henneberg and his colaborers, including Stohmann, Maercker, Schulze, Lehman, and others in Göttingen; of Gustav Kühn and his associates in Möckern, and of Grandeau and Leclerc in Paris.

Many other investigations, as those of Lawes and Gilbert and E. Smith, in England, have been of great value in the development of the general subject of metabolism, although the balance of matter and energy was not the special subject under consideration.

Very important experiments, in which the relation of carbon dioxid excreted to oxygen consumed—i. e., the respiratory quotient—have been made by Zuntz and his followers in Berlin and by Pflüger and others in his laboratory at Bonn. Similar researches, which are perhaps of equal importance, are being conducted by other investigators.

Finally, the work of Rosenthal in Erlangen and Rubner in Marburg, in the development of a respiration calorimeter, deserves especial mention, as well as the calorimetric experiments of Pashutin and Studenski with animals, and of Likhachev with man, in St. Petersburg.

Several more or less complete summaries of experiments in metabolism have been made. Among others the following may be mentioned:

In 1861[1] and, later, in 1876,[2] Wolff published summaries of experimental inquiry in these lines, which had been made up to that time on the feeding of domestic animals. In 1881 Voit published his "*Physiologie der allgemeinen Stoffwechsels und der Ernährung*,"[3] in which the subject of metabolism is very thoroughly treated from a physiological standpoint. A great deal of historical and critical information is included, and a large number of experiments with man and animals are quoted in more or less detail. A similar treatise, from a somewhat different standpoint, was published in 1886 by Munk and Uffelmann.[4] A brief review of the subject and its literature was also published by Munk[5] in 1889. In 1893 von Noorden[6] published a volume, in which the subject of metabolism is exhaustively treated from the standpoint of health and disease. A large number of experiments are quoted in detail, and an extended bibliography of the subject is given.

SCOPE AND PLAN OF THIS COMPILATION.

In the present compilation the attempt was made to collect as many as possible of the experiments in which the metabolic balance was determined. In most cases this means the balance of nitrogen or nitrogen and carbon. In a number of experiments the balance of phosphorus, sulphur, or other mineral matter was also determined. The experiments were made with men, women, and children, and with cattle, dogs, sheep, and other animals. A total of 3,661 individual tests or averages is included. Of these 2,299 were made with man, 383 with cattle and horses, 928 with sheep, dogs, and other domestic quadrupeds, and 51 with poultry and doves. In 2,234 tests with man and 1,156 with animals the nitrogen balance was determined, and in 65 with man and 206 with animals the balance of carbon and nitrogen was determined.

A few experiments have been made with such insects as silkworms,[7] bees,[8] etc. However, no attempt was made to include them in the present compilation.

The experiments with men, women, and children were made under various conditions of health and disease; those with animals were usually made for a study of various economic problems. In compiling the results the plan followed was to divide the experiments made with man, in which the nitrogen balance, with or without the balance of mineral matter, was determined, into two general classes, (1) those in

[1] Die landwirtschaftliche Fütterungslehre und Theorie der Menschlichen Ernährung.

[2] Die Ernährung der landwirtschaftlichen Nutzthiere.

[3] Hermann's Handbuch der Physiologie, Vol. VI.

[4] Munk and Uffelmann's Ernährung des gesunden und kranken Menschen.

[5] Real-Encyclopädie der gesammten Heilkunde, vol. 19, pp. 148–167.

[6] Lehrbuch der Pathologie des Stoffwechsels.

[7] Peligot, Compt. Rend., 61 (1865), p. 866; Ann. Chim. et Phys., 12 (1867), p. 445.

[8] Dumas and Milne-Edwards, Ann. Chim. et Phys., ser. 3, 14, p. 400; ser. 2, 14 (1820), p. 89; 22, p. 35. Compt. Rend., 17 (1843), p. 531.

which the subjects were in health, and (2) those in which the subjects were suffering from some disease. The first class was further subdivided into experiments in which the influence of diet was studied, and those in which the influence of other conditions was also investigated. The second class was subdivided according to the diseases from which the subjects were suffering, following Osler's classification[1] of diseases.

The experiments with man in which the balance of nitrogen and carbon with or without hydrogen, oxygen, and mineral matters was determined form a group by themselves.

The experiments with each kind of animal in which the nitrogen balance was determined were grouped by themselves. As far as possible the groups were subdivided as in the case of man. The experiments with animals in which the balance of nitrogen and carbon with or without hydrogen, oxygen, and mineral matters was determined form a group by themselves. And, finally, the last group is made up of experiments in which the balance of energy was determined.

The attempt was not made to include experiments published since 1894, though a few of later date are quoted.

A brief reference to the journals and other publications consulted in making up the present compilation may not be out of place. The complete files of *Jahresbericht der Thier-Chemie*, *Jahresbericht der Agrikultur-Chemie*, and the *Index Medicus*[2] were consulted, and the original articles referred to in these journals were examined for the data quoted in the tables. In addition, the references in Voit's, Munk and Uffelmann's, and von Noorden's works were quite generally examined, as well as the references in the bibliographies contained in the reports of the individual experiments quoted. The complete files of *Zeitschrift für Biologie*, *Archiv für Hygiene*, *Landwirthschaftlichen Versuchs-Stationen*, *Zeitschrift für physiologische Chemie*, *Archiv für die gesammte Physiologie*, *Annales de la Science Agronomique*, and *Vrach* from 1885 to 1895 were also examined.

Many volumes, though not the complete files, of the following publications were examined: *Archiv der Heilkunde*, *Archiv für Kinderheilkunde*, *Archiv für klinische Medizin*, *Archiv für pathologische Anatomie und Physiologie*, *Archiv für Physiologie*, *Berliner klinische Wochenschrift*, *Zeitschrift für Heilkunde*, *Zeitschrift für klinische Medizin*, *Jahrbuch für Kinderheilkunde*, *Landwirthschaftliche Jahrbücher*, *Münchner medicinische Wochenschrift*, *Comptes Rendus de l'Académie des Sciences, Paris*, *British Medical Journal*, and many other periodicals and special works on physiology and physiological chemistry, and inaugural dissertations. While it can not be claimed that the present compilation is complete, it is believed that few of the recorded experiments have escaped notice.

[1] W. Osler, Principles and Practice of Medicine.

[2] Only those sections were examined which it was believed would contain experiments of the nature sought.

The purpose of this work is primarily to give a brief epitome, so far as practicable, of the objects and results of individual experiments. The tables quoted furnish the framework of such an epitome, while supplementary data are given in the accompanying text. It is hoped that the two together will enable the reader to learn what investigations have been made and by whom, what balances were determined, where the original accounts were published, and the general character of the results.

Generally speaking, only average figures have been included in the compilation. For instance, if the results of each of the six days of a period on a particular diet were given in the original publication, only the average is quoted. This was done because it was believed that the average results were usually sufficient for an understanding of the investigation. Sometimes, where this did not seem to be the case, the experiments have been quoted with more detail, and individual days or such averages as seemed most desirable have been included. The attempt has always been made to give sufficient material for the clear understanding of the experiments quoted.

It is the opinion of many that the experimental methods followed in metabolism investigations are not accurate enough to warrant the numerical expression of results with more than one decimal place. This has, indeed, been the more common practice. Many investigators in computing the results have, however, used two or more decimal places. For the sake of uniformity, the plan followed in the compilation has been to use only one decimal place, adding 1 to the first decimal digit if the second was 5 or over. In some few cases this causes slight discrepancies between the original and the quoted results, and in a few instances the author's conclusion is not quite so clearly brought out as is the case when the decimal is given in full.

In the experiments with man the age, sex, and occupation of the subject have been given when possible. When not otherwise stated, the subject is supposed to be a man. Considerable variation was observed in the statements concerning the weight of subjects. Sometimes this was expressed in kilograms or pounds and sometimes in grams, and in some experiments the daily weight of the subject was recorded and in others the weight at the beginning or end of the period. For the sake of uniformity the approximate weight is given in the tables whenever possible.

In the text sufficiently full statements have been made of the methods followed by the investigators to make it possible to judge of the relative value of their work.

In most of the experiments the figures quoted were actually determined. A number of experiments are, however, included in which the experimenters themselves computed the composition of the food or feces, or both. Some few experiments are also included in which the food or feces, or both, were not analyzed nor was the composition computed

by the investigator. In such cases it was believed that the missing data could be supplied by the compilers with reasonable accuracy from available material. This was accordingly done, and figures so obtained are inclosed in parentheses to show that the calculations were made by the compilers and not by the investigators. In a few experiments the authors determined the urea and uric acid in the urine and did not determine the total nitrogen. In such cases the nitrogen of the urine was computed by the compilers from the data given. It was believed that this would not introduce any considerable error, since the chief nitrogenous compounds in the urine are uric acid, urea, and extractives, and the amount of the last is small.

Frequently the authors have given additional data of a different nature from those included in the tables. Reference is usually made to such data in the text accompanying the tables, and in many cases the information is briefly summarized.

When the published account of experiments covers more than one class, the usual plan has been to include all the experiments in the class to which the majority of them belong. In a few cases, however, the experiments have been divided, each sort being tabulated in its proper place.

POINTS TO BE CONSIDERED IN DRAWING DEDUCTIONS FROM THE EXPERIMENTS.

In judging of the value of any series of experiments for general deductions the care with which the experiments were made and the methods followed should be taken into account. Among other things—

(1) The experiments must be made under suitable conditions, especially as to character, environment, and treatment of the subject, be the latter a man or a lower animal. Whether or not the subject is in such close confinement as to disturb the bodily functions; or whether the subject is fasting or fed, at work or at rest, should be definitely stated. Unless the effects of some particular disease or some other unusual condition are to be studied the bodily condition should be normal. If the subject is in a respiration apparatus, care should be taken that the confinement does not become so irksome as to derange the functions. The food should not be such as to disagree with the subject, and thus disturb the normal processes of metabolism.

(2) The experiments should be made with several different subjects, and should be repeated in order to make sure that the results are representative and not exceptional. Results of individual tests are affected by individual peculiarities of the subjects, and these idiosyncrasies vary not only with different subjects, but with the same subject at different times. A given diet furnishing certain amounts of protein and energy may be taken by three different men under the same conditions of environment and labor, and while it meets the demands of the first it may be too much for the second or too little for the third; or

it may suffice very well for either one at a given time and be too much or too little at another time. This fact is to be especially considered in studies of dietaries. Again, certain predigested foods—so-called peptones and the like—may be very efficacious in a particular case, but it would be unwarranted to predicate a specific value without considerable duplication of experiments. These statements apply with special force where the conditions are abnormal; e. g., where a special form of disease, or fasting, or unusual muscular exertion is a factor.

(3) The experiments must be of a suitable length, yet not long enough to disturb normal functions. With too short a period, it is not certain how far the observed results represent the actual effect of the feeding or treatment which is to be tested. On the other hand, if the food or treatment be unusual or disagreeable, lengthening the experimental period unduly may vitiate the results.

One other important question in this connection is, What period should be taken for the measure of the metabolism of the food of a day or given number of days? Unfortunately there is very little exact knowledge as to when the change in metabolism corresponding to a change in diet occurs, or how soon such a change of metabolism will reach a constant level.

For instance, it can not be said that the metabolism of nitrogen, carbon, and energy for a period of 24 hours corresponds to the food of either the same period or of the 24 hours previous, or of any other exact period that can be named. The factors that enter into this question are very complex and the exact data at hand unfortunately few. If, therefore, a definite measure for the effect of food is desired it must be sought by making the experiment cover a long period. Part of this period should properly be considered as preliminary, during which time the body is adjusting itself to the changed diet and the metabolism is reaching the constant value corresponding to that diet. One factor of this constant value is the nitrogen equilibrium which can be quickly determined. When this point is attained the experiment may be continued long enough to show the actual effect of the food or other conditions, e. g., muscular work upon metabolism.

(4) The proper separation of the urine, feces, and respiratory products is a matter of great importance. In order to establish a balance of nitrogen when a certain diet is followed, the feces must be taken into account. It may be that the feces which are due to the particular food do not appear for several days after the food is consumed. Some of the early experiments are less valuable than they would otherwise be because this fact was overlooked. It was generally assumed that the feces excreted on a given day were due to the food consumed the preceding day. This may or may not be the case. Several methods of definitely marking the feces are in use. One of the best methods, perhaps, is to give very finely powdered charcoal, either in capsules or

some other convenient form, with the last food eaten before the experiment begins and the first food eaten after it is finished. The charcoal imparts to the feces a dark bluish-black color of varying intensity, and the line between the charcoal feces and that which precedes or follows it is sharply drawn. The separation is then only a mechanical matter.

The collecting of urine is a comparatively simple matter in experiments with men, and can generally be accomplished without great difficulty. To know just what should be the period for collecting urine to represent the nitrogenous material metabolized during an experimental period is another and far more difficult matter. Certainly part of the nitrogen of the food finds its way into the bladder in a very short time. Thus the odor due to asparagus may be detected in the urine within an hour after it is eaten. But when the metabolism of nitrogen is increased by muscular labor the increased excretion of nitrogen may continue for many hours after the labor has ceased. No generally accepted method exists of identifying the urine due to a particular food, and the experiment should always be of sufficient duration to eliminate as much as possible the error which may arise from this fact. It has been frequently assumed that the urine excreted on a particular day may be taken as representing the food metabolized on that day, but this is hardly correct. In other cases the urine of 24 hours is taken as representing the nitrogen metabolized during the previous 24 hours. The subject demands more experimental study than it has received. (See Nos. 2660–2698, Table 28.)

If the estimation of excretory nitrogen is to be perfectly exact, the perspiration and "accidental" excretory products, such as hair, nails, epithelial cells, etc., which are lost, must be taken into account, measured, and analyzed. It is usually assumed that no great error is involved by neglecting them altogether.

Very little can be said of the separation of the respiratory products due to a particular diet. The usual plan has been to let the subject consume a uniform diet for several days and then make the respiration experiment, the diet being unchanged. Most of the respiration experiments have so far been of short duration—12 or 24 hours. In the case of animals it has been possible to keep the subject in the respiration chamber for a longer time than 24 hours without inconvenience. It was thought that in the case of man the continued confinement might prove very irksome, and so disturb the normal functions of the organism. In late experiments (Nos. 2277–2306, Table 26) this was not found to be the case. The extent to which the disturbance of normal functions would occur would doubtless depend upon the temperament of the subject.

(5) In the collection, measurement, and analyses of the food, urine, feces, and respiratory products lies one of the most difficult problems encountered in experiments of this nature. It is very difficult to obtain fair and representative samples of some articles of food—for instance, fresh meat. Yet this must be done or it is manifestly impossible to

compute the factors of the income. When a fair sample is obtained it must be analyzed by methods which are known to give accurate and reliable results. Much work which has been done loses a considerable part of its value because analyses of the food consumed were not made. When the composition is determined by using calculations based on reliable figures the work has value. It is, however, very generally recognized that the food used must be analyzed.

Little difficulty attends the collection of urine. In the analysis of urine it is important that the method be perfectly reliable. In experiments which include only the nitrogen balance it has been customary with many experimenters to determine the urea by gravimetric methods and compute the nitrogen from this. The results by this method are not always satisfactory.

In experiments which include the balance of carbon, oxygen, and hydrogen it is not enough to calculate these elements from the amount of urea, or urea and water. Elementary analyses must be made, since the urine contains other compounds.

The feces may be easily collected and should always be analyzed. It has been sometimes a custom to assume that a particular diet would always yield feces of a practically unvarying composition. This is at best only a supposition. At present there is no entirely satisfactory method of determining what part of the nitrogen of the feces is due to undigested residue and what part is due to such metabolic products as bile, coloring matter, etc. (See Nos. 418–420, Table 7; No. 2620, Table 28.) At present a small error seems unavoidable, due to the fact that the methods now in use are not perfectly exact.

The methods of preparing samples of food, urine, and feces, and the methods usually employed in their analysis, have been spoken of at length in a previous publication.[1]

The measurement and analysis of the inspired air and the respiratory products calls for complicated apparatus, but these determinations are necessary if any dependence is to be placed on results which include the balance of carbon, oxygen, and hydrogen.

Marsh gas is formed in considerable quantity by the action of bacteria on carbohydrates in the intestines of Herbivora. It is also formed under certain circumstances in the intestines of man. The carbon of marsh gas is thus due to a gaseous excretory product of the intestines, and is not a respiratory product.

The methods of collecting and analyzing respiratory products which have been employed in the past are treated of under the individual respiration experiments. (See Tables 27 and 38.)

(6) In order to establish a balance of energy it is necessary to determine the thermal value of the food, urine, and feces, with a bomb calorimeter or by some other suitable method.[2] The energy manifested as

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 113.

heat radiated from the body must be measured, and that which is manifested as external work must be measured and reduced to terms of heat. It is evident that problems of this sort call for complicated apparatus and a knowledge of the methods used in physical research.

In discussing nutrients and their functions little has been said concerning mineral matter or, as it is commonly called, ash. Some mineral matter is required for the formation and repair of tissue. Since, however, the salts ordinarily consumed possess little or no potential energy, they are necessarily of little importance in furnishing the body with force. The mineral constituents have some function in nutrition which is not at present understood.[1] Sodium and chlorin are apparently necessary constituents of blood serum, and potassium and phosphorus of the red corpuscles. Phosphorus is absolutely essential for growth, and sulphur is hardly less important.

As will be seen by reference to the tables, few experiments have been made in which the balance of income and outgo of mineral constituents was attempted. Though the theory of the function of mineral matter does not rest upon such experiments alone, yet data of this nature are undoubtedly very valuable, and this is a line of research which might be profitably extended.

ACCURACY AND COMPLETENESS OF THE COMPILATION.

In conclusion the compilers call especial attention to the fact that the present compilation is intended to cover only a definite line of metabolism experimenting. Very many experiments of a different nature have been made which are of great value in drawing deductions concerning the general laws of nutrition. Such, for instance, are experiments in which the ratio of inspired oxygen to expired carbon dioxid was determined under varying conditions. In a previous publication of this Office[2] an attempt was made to compile the more important dietary and digestion experiments made with man. The results as published include, however, only a part of the material collected.

As regards the correctness of the statements here compiled, the authors can only say that they have endeavored to avoid inaccuracy so far as was in their power. They are aware that errors of detail will doubtless be found in such a compilation, both in the figures and in other data.

As already stated, no claim is made that all the experiments are cited. Despite the efforts made it is certain that some have been overlooked. A number of experiments with man and animals were omitted because the feces were not analyzed. These might have been included by computing the composition of the feces, since the feces do not vary within very wide limits.

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[1] For general statements on this subject see Text-book of Physiology, by M. Foster.

[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

EXPERIMENTS WITH MAN.

There is no essential difference between man and other vertebrates as regards the metabolism of matter and energy. The details of the process may vary, but the final products are essentially the same. The materials burned yield carbon dioxid, water, and urea and kindred compounds, providing energy for internal and external muscular work and the heat necessary for maintaining the body temperature. A partial exception to these statements may perhaps be found in the relation of intellectual and nervous action to metabolism, but this is a matter as yet but little understood though demanding careful investigation.

In studying the general principles of metabolism the selection of man or one of the lower animals as a subject is largely a matter of convenience. In the study of special questions, however, the nature of the investigation usually determines the choice of a subject.

EXPERIMENTS IN WHICH THE NITROGEN BALANCE WAS DETERMINED.

HEALTHY SUBJECTS, INFLUENCE OF DIET.

Experiments with man in which the balance of income and outgo of nitrogen has been determined, with or without mineral matter, constitute about two-thirds of the experiments recorded in this compilation. They have been divided into two general classes—those in which the subjects were in health and those in which they were suffering from some disease. The experiments with men in health have been further subdivided. In the first group the influence of special food materials or various forms of diet has been studied. In the second group the influence of other conditions than diet were studied. Some of these were more or less abnormal or unusual.

EXPERIMENTS WITH A VEGETARIAN DIET.

In Table 1 are included 22 tests with men and 2 with women in which the object was to study the value of a more or less strictly vegetarian diet. Many so-called vegetarians do not strictly deserve the name, for although they omit meat from their dietary they consume considerable quantities of dairy products and eggs, which are derived from animal sources. While numerous works have been published on the subject of vegetarianism, the actual experiments with man are not numerous. Information is usually derived from artificial-digestion experiments and not from actual experiments made with living subjects. A few experiments are also included, which were made with diseased subjects to test some form of diet, the disease being left out of account, or which were made for the purpose of comparison. (See also Table 3.)

TABLE 1.—*Experiments with a vegetarian diet.*

Serial number.	Date of publication.	Observer.	Subject: Occupation.	Subject: Age.	Subject: Weight.	Food per day.	Duration.	Nitrogen: In food.	Nitrogen: In urine.	Nitrogen: In feces.	Nitrogen: Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1	1882	Cramer	So-called vegetarian	64		Milk, bread, fruit, etc	3	11.8	8.4	2.5	+0.9	
2	1887	Constantinidi	Laboratory servant.			1,700 gm. potatoes, 200 gm. wheat gluten, 100 gm. fat, 500 cc. beer, 10 gm. salt, 1,600 cc. water.	3	31.7	24.1	2.0	+5.6	
3	1887	do	do			1,700 gm. potatoes, 100 gm. fat, 500 cc. beer, 10 gm. salt, 1,600 cc. water.	3	7.2	8.2	1.4	—2.4	
4	1888	Rutgers	Man	36	55	Beans, peas, butter, bread, potatoes, meat extract, etc.	3	20.9	11.6	4.1	+5.2	
5	1888	do	do	36		do	2	20.9	15.4	4.9	+0.6	
6	1888	do	Woman	39	49	do	1	13.9	10.9	2.5	+0.5	
7	1888	do	do	39		do	2	13.9	11.2	2.2	+0.5	
8	1889	Voit	Vegetarian	28	57	Bread, fruit, etc	14	8.4	5.3	3.5	—0.4	
9	1889	do	Laboratory servant.		74	Fat, starch, etc		0.0	9.5	0.0	—9.5	Nitrogen-free diet.
10	1889	do	do		74	Bread, fruit, etc	3	8.3	9.7	3.5	—4.9	Vegetable diet.
11	1889	Avsitidiski	Man (A.)		71.4	800 gm. bread (2 days' black), 304 gm. meat, 700 cc. bouillon, 50 gm. butter, —— sugar, 2,270 cc. water.	10	29.9	26.0	1.8	+2.1	Mixed diet.
12	1889	do	do		71.5	1,000 gm. bread, 696 gm. pea soup, 153 gm. buckwheat, 267 gm. wheat meal, 140 gm. macaroni, 300 gm. potatoes (2 days), 124 gm. rice, 380 gm. peas (1 day), 200 gm. cabbage (1 day), 50 gm. butter, —— sugar, 2,270 cc. water.	10	27.5	16.7	4.5	+6.3	Vegetable diet.
13	1889	do	Man (K.)		60.5	940 gm. bread (2 days' black), 302 gm. meat, 840 cc. bouillon, 50 gm. butter, —— sugar, 2,390 cc. water.	10	32.4	25.4	3.0	+4.0	Mixed diet.
14	1889	do	do		61	1,200 gm. bread, pea soup, 175 gm. buckwheat, wheat meal, 150 gm. macaroni, 300 gm. potatoes (1 day), 120 gm. rice, 410 gm. peas, 200 gm. cabbage, 50 gm. butter, —— sugar, 2,470 cc. water.	10	31.2	19.6	4.7	+6.9	Vegetable diet.
15	1889	do	Man (E.)		69.9	980 gm. bread (2 days' black), 590 gm. pea soup, 221 gm. buckwheat, 240 gm. wheat meal, 210 gm. macaroni, 280 gm. potatoes (2 days), 236 gm. rice (2 days), 134 gm. peas, 200 gm. cabbage (1 day), 50 gm. butter, —— sugar, 2,550 cc. water.	10	27.7	20.0	4.4	+3.3	Do.

16	1889	.....do	.... do	....	70	798 gm. bread (3 days' black), 339 gm. meat, 800 cc. bouillon, 50 gm. butter, —— sugar, 2 260 cc. water.	10	29.4	24.6	2.0	+2.8	Mixed diet.
17	1889	.....do	Man (B.)	....	68	942 gm. bread (2 days' black), 590 gm. pea soup, 220 gm. buckwheat, 230 wheat meal, 190 gm. macaroni, 243 gm. potatoes (2 days), 288 gm. rice (2 days), 130 gm. peas, 200 gm. cabbage (1 day), 50 gm. butter, —— sugar, 2,155 cc. water.	10	26.8	17.5	3.9	+5.4	Vegetable diet.
18	1889	.....do	.....do	....	68.3	800 gm. bread (3 days' black), 298 gm. meat, 900 cc. bouillon, 50 gm. butter, —— sugar, 2,490 cc. water.	10	28.6	23.2	2.8	+2.6	Mixed diet.
19	1889	.....do	Man (I.)	....	65	950 gm. bread (2 days' black), 580 gm. pea soup, 220 gm. buckwheat, 240 gm. wheat meal, 170 gm. macaroni, 240 gm. potatoes (2 days), 305 gm. rice (2 days), 130 gm. peas, 200 gm. cabbage (1 day), 50 gm. butter, —— sugar, 2,010 cc. water.	10	26.7	17.3	5.0	+4.4	Vegetable diet.
20	1889	.....do	.....do	....	67.4	800 gm. bread, 306 gm. meat, 900 cc. bouillon, 58 gm. butter, —— sugar, 2,338 cc. water.	10	29.2	24.0	2.1	+3.1	Mixed diet.
21	1892	Taniguti	Servant	....	....	Rice and vegetables	10	9.6	9.2	1.9	—1.5	
22	1892	.....do	.....do	....	....	.....do	10	10.5	8.4	2.1	0.0	
23	1892	.....do	.....do	....	....	.....do	10	10.3	7.2	1.9	+1.2	
24	1892	.....do	.....do	....	....	.....do	5	10.4	7.5	2.4	+0.5	

No. 1. Ztschr. Physiol. Chem., 1882, p. 357. Nos. 2, 3. Ztschr. Biol., 23, pp. 447, 450. Nos. 4-7. Ibid., 24, p. 379. Nos. 8-10. Ibid., 25, pp. 265, 275. Nos. 11, 12. The metabolism of nitrogen and losses through skin and lungs on a vegetable diet. Inang. Diss. (Russian), St. Petersburg, 1889, Table 1. Nos. 13, 14. Ibid., Table 2. Nos. 15, 16. Ibid., Table 3. Nos. 17, 18. Ibid., Table 4. Nos. 19, 20. Ibid., Table 5. Nos. 21-24. Jahrb. Thier-Chem., 1892, p. 468.

No. 1 was made by Cramer in 1882 in connection with a study of the dietary of a so-called vegetarian. The subject was an official of high rank in the German civil service. He was in good health and possessed of a great deal of physical endurance. He was not a strict vegetarian, for although vegetable food formed the greater part of his diet, milk and eggs were also consumed. His diet was a matter of choice and had been followed for many years. Analyses of food, urine, and feces were made.

The conclusion is reached that the dietary followed furnished the subject with sufficient nutriment, but if the animal food was omitted it would not do so. It is urged that a strictly vegetarian diet is not desirable because a large quantity of food must be consumed in order to obtain sufficient protein. This calls for much unnecessary labor by the digestive organs. The diet is also condemned from an economical standpoint. The same amount of nutriment in a better balanced ration can be purchased with a definite sum when a mixed dietary is followed than when only vegetable food is consumed.

Nos. 2, 3 were made by Constantinidi in the Munich laboratory in 1886. The object of the investigation was to see if the vegetable protein would furnish a fair substitute for animal protein, as ordinarily consumed in meat, or any other expensive proteid substance. The subject was a laboratory servant. The diet consisted of potatoes cooked in water, to which fat was added, and "gluten," a vegetable proteid compound made from waste products of wheat. Beer was used as a beverage. The food and excreta were analyzed. The separation of the feces was effected by means of milk. The body made a daily gain of 3.6 grams nitrogen. When a second experiment was made like the above, but without the gluten, the body lost 2.3 grams of nitrogen per day. The gluten furnished, therefore, a valuable and cheap nitrogenous food.

Nos. 4–7 were made by Rutgers in Amsterdam in 1887. The object was to determine whether vegetable protein had the same nutritive value as animal protein. The subjects were the investigator (a physician) and his wife. The time covered by the whole experiment was 10 weeks. During the first period a simple mixed dietary, consisting of meat, milk, bread, rice, potatoes, etc., was followed. During the second period meat and milk were omitted, and beans and peas were consumed instead. The amount of protein, fat, and carbohydrates was in each case the same. The composition of the food was estimated from König's figures except in the case of some Tokay wine, which was analyzed. The food was very carefully prepared, in order that it might be uniform each day. The cost of the diet which contained animal food was 2.61 marks (62 cents) per day, while that of the diet containing only vegetable food was 2.22 marks (55 cents). The amount of urine and its specific gravity were determined daily, as well as the approximate amount of nitrogen. On three days the nitrogen was accurately determined. The feces were weighed each day, and on three days the nitrogen was determined. It is presumable that the figures obtained are fairly representative of the whole period, since variations from the regular routine were avoided as much as possible. No particular inconvenience was experienced in following either dietary, nor did the food become distasteful.

The conclusion is reached that the animal protein can be replaced by vegetable protein without any particular change in the nitrogen balance. From an economic standpoint, the only difference in the cost of the two kinds of diet was due to the fact that less fuel was needed to prepare the vegetable food.

Nos. 8–10 were made by Voit in the laboratory of the Physiological Institute, in Munich, in 1886. The object of these experiments was an investigation of the merits of a vegetarian diet as compared with a mixed diet. In No. 8 the subject was an upholsterer. In Nos. 9 and 10 the subject was the laboratory servant, so often used for experiments by Voit and his associates. The upholsterer was a strict vegetarian. For three years his dietary had consisted entirely of bread, fruit, and oil. No warm food was eaten. The man was normally developed and appeared healthy and well nourished.

For purposes of comparison the laboratory servant was given the same kind of food which was relished by the vegetarian. It was, however, very distasteful to

him, and after a few days could not be eaten. The food and feces were analyzed and the nitrogen in the urine was determined. The vegetarian was practically in a condition of nitrogen equilibrium with this diet. It was, however, not sufficient for the laboratory servant. He lost considerable nitrogen, though less than when no food was consumed. If the diet had been followed for a longer time it is possible that a condition of nitrogen equilibrium would have been reached.

Voit's conclusion is that it is perfectly possible for a person to subsist entirely on vegetable food, but that a mixed diet is to be preferred.

Nos. 11–20 were made by Avsitidiski in St. Petersburg in 1889. The object was to study the metabolism of nitrogen and losses through the skin and lungs on a vegetable diet. The subjects were prisoners of the St. Petersburg civil prison, all healthy men, between 20 and 29 years of age. Five series of experiments are described, each of which was divided into two 10-day periods. In two series (Nos. 11–14) the subjects were on a mixed diet during the first period and on a vegetable diet during the second period, while in the other three series (Nos. 15–20) the conditions were reversed, and a preliminary period of two days on a special preparatory diet preceded the test proper. There was an interval of three days between Nos. 19 and 20, during which time the subject was suffering from diarrhea.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The excretion through the skin and lungs was calculated by the method of Sanctorius—that is, from the original weight of the body plus the total income for the period was subtracted the weight at the end of the period plus the weight of the outgo.

In all the experiments the metabolism and assimilation of nitrogen were less on the vegetable diet than on the mixed diet. The excretion through the skin and lungs in all cases was greater on the vegetable diet than on the mixed diet.

Nos. 21–24 were made by Taniguti in the Japanese Imperial Military Medical School at Tokyo in 1892. The object was an investigation of the value of the Japanese rice diet. The subject was a healthy laboratory servant. The food was rice or rice and some other vegetable food. In one test takann (salted vegetables, chiefly turnip) and meat extract were each used as condiments. Miso (a thick sauce made from soy beans) was also eaten. Few details are quoted. In most cases there was a small gain of nitrogen.

EXPERIMENTS WITH A MILK DIET.

In Table 2 are included 46 tests with men, 6 with women, and 17 with children in which the influence of a milk diet was studied. A number of the experiments were dietary or digestion studies, in which the balance of income and outgo of nitrogen was also determined.

When milk or other single food is consumed for several days the monotonous diet often becomes so repulsive as to cause more or less pronounced digestive disorders. On an absolute milk diet, in order to supply the subject with the necessary amount of protein and energy, a large quantity of milk must be consumed. If the amount taken at any one time is large, digestive derangements sometimes result, owing to the formation of masses of coagulated milk in the stomach. This may be prevented in a measure by consuming dry bread or other similar food with the milk. It is uncertain how much, if any, the digestibility and assimilation of milk are affected by the addition of other food to the diet.

A number of experiments with diseased subjects in which milk was the principal or only food consumed are included in Table 18 (Nos. 1507–1546) and Table 19 (Nos. 1869–1878).

TABLE 2.—*Experiments with a milk diet.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
25	1879	Rubner	Man	27	71	2,438 cc. milk	3	15.4	13.5	1.0	+ 0.9	
26	1879	do	do		71	2,050 cc. milk	1	12.9	12.6	0.9	— 0.6	
27	1879	do	do		71	3,075 cc milk	1	19.4	16.6	1.5	+ 1.3	
28	1880	Hoffmann	Physician		66.2	2,713 cc. milk	3	11.5	20.1	1.5	—10.1	
29	1880	do	do		69.4	—— cc. milk	3	14.6	17.4	1.4	— 4.2	
30	1880	Slatkowsky	Man (N.)			3,698 cc. milk	3	22.6	20.4	1.4	+ 0.8	
31	1880	do	do			4,619 cc. milk	2	28.2	23.8	1.4	+ 3.0	
32	1880	do	Man (M.)			3,113 cc. milk	3	19.0	18.9	0.8	— 0.7	
33	1880	do	do			2,504 cc. milk	2	21.4	24.1	0.8	— 3.5	
34	1880	do	Woman (O.)			3,227 cc. milk	3	20.3	12.3	1.0	+ 7.0	
35	1880	do	do			3,346 cc. milk	2	21.1	13.5	0.9	+ 6.7	
36	1880	do	Man (N.)			4,747 cc. milk	3	29.4	23.9	1.7	+ 3.8	
37	1880	do	do			4,870 cc. milk	2	30.2	26.0	1.5	+ 2.7	
38	1880	do	Man (M.)			3 064 cc. milk	3	19.0	17.8	0.8	+ 0.4	
39	1880	do	do			3,064 cc. milk	2	19.0	18.9	0.7	— 0.6	
40	1880	do	Man (N.)			5,217 cc. milk	3	32.3	26.8	1.8	+ 3.7	
41	1880	do	do			5,200 cc. milk	2	32.3	28.4	1.7	+ 2.2	
42	1880	do	Man (M.)			3,132 cc. milk	3	19.4	20.0	0.8	— 1.4	
43	1880	do	do			2,376 cc. milk	2	19.4	20.9	0.7	— 2.2	
44	1880	Laptschinsky	Man	26	54.8	3,270 cc. milk, a little bread	6	20.0	11.7	0.8	+ 7.5	
45	1880	do	do	46	62.1	3,228 cc. milk, a little bread	7	17.0	19.5	1.3	— 3.8	
46	1880	do	do	22	64.8	3,405 cc. milk, a little bread	6	19.6	18.5	1.0	+ 0.1	
47	1880	do	do	23	67.4	3,399 cc. milk, a little bread	6	19.8	16.7	2.2	+ 0.9	
48	1880	do	do	24	73.1	2,385 cc. milk, a little bread	5	13.1	14.1	0.8	— 1.8	
49	1882	Camerer	Girl	12		1,790 cc. milk, 125 cc. water or coffee	3	10.2	9.7	0.5	0.0	
50	1882	do	do	10		1,914 cc. milk, 125 cc. water or coffee	3	10.9	9.6	0.4	— 0.9	
51	1882	do	Boy	6¼		1,959 cc. milk, 127 cc. water or coffee	3	9.2	10.8	0.5	— 2.1	
52	1882	do	Girl	5⅚		1,270 cc. milk, 362 cc. water or coffee	3	8.1	8.6	0.6	— 1.1	
53	1882	do	do	4⅙		1,854 cc. milk, 100 cc. water or coffee	3	8.7	8.3	0.8	— 0.4	
54	1885	Rudenko	Observer		70	171 gm. meat, 286 gm. bread, 123 gm. potatoes, 395 cc. bouillon, 317 cc. milk, 1,040 cc. tea, 105 gm. sugar.	2	(12.8)	16.4	1.2	— 4.8	
55	1885	do	do		70	2,239 cc. milk	3	14.5	16.8	0.8	— 3.1	
56	1885	do	Man		112	1,550 cc. milk	1	10.8	19.8	(0.8)	— 9.8	First day on milk diet.
57	1885	do	do		109	1,750 cc. milk	5	12.0	15.9	(0.8)	— 4.7	First to fifth day after No. 56.
58	1885	do	Coachman (E.)	44	51	1,759 cc. milk	15	11.1	12.7	0.4	— 2.0	Insuff. v. v. aortæ et ectasia bulbi aortæ.

59	1885	.....do	.....do	44	56.3	1,175 cc. milk	1	7.5	10.3	0.3	— 3.1	First day of No. 58.
60	1885	.....do	.....do	44	49.2	2,420 cc. milk	1	15.8	16.1	0.8	— 1.1	Last day of No. 58. Nitrogen in urine = mean of last day of period and following day.
61	1885	.....do	Tailoress (N.)	35	44	1,583 cc. milk	16	8.9	7.8	2.2	— 1.1	Insuff. v. v. aortæ. Nitrogen in feces = mean of fifteen days.
62	1885	.....do	.....do	35	45.7	877 cc. milk	1	5.0	5.2	4.9	— 5.1	First day of No. 61. Milk and consumed nitrogen = average of first day of period and preceding day.
63	1885	.....do	.....do	35	44.3	1,842 cc. milk	1	9.0	7.8	0.7	+ 0.5	Last day of No 61.
64	1885	.....do	.....do	35	43.8	2,217 cc. milk	1	11.5	9.2	2.2	+ 0.1	Twelfth day of No. 61. Maximum milk diet.
65	1885	.....do	Janitor (I.)	62	61	2,591 cc. milk	8	14.4	11.6	2.1	+ 0.7	Tumor mediastinum.
66	1885	.....do	.....do	62	63	2,353 cc. milk	1	13.4	15.9	0.8	— 3 3	First day of No. 65. Milk and nitrogen in milk = mean of first day of period and preceding day.
67	1885	.....do	.....do	62	63.1	2,775 cc. milk	1	16.4	8.6	1.4	+ 6.4	Last day of No. 65. Nitrogen in urine and feces = mean of last day of period and following day.
68	1885	.....do	Clerk (A.)	30	68	1,366 cc. milk	19	7.5	11.1	1.5	— 5.1	Nephritus diffusa. Nitrogen in urine and feces = mean of eighteen days only.
69	1885	.....do	.....do	30	76.5	856 cc. milk	1	4.4	8.7	0.3	— 4.6	First day of No. 68. Nitrogen in feces = second day.
70	1885	.....do	.....do	30	64.5	1,210 cc. milk	1	7.4	11.5	1.7	— 5.8	Last day of No. 68. Nitrogen in urine and feces = mean of last day of period and following day.
71	1885	.....do	Clerk	30	66.2	1,928 cc. milk	2	11.0	12.8	1.2	— 3.0	Twelfth and thirteenth day of No. 71. Maximum milk diet.
72	1885	.....do	Mechanic (K.)	51	58	1,595 cc. milk	20	8.8	6.5	0.9	+ 2.4	Nephritus diffusa.
73	1885	.....do	.....do	51	59	1,227 cc. milk	1	6.5	6.9	1.3	— 1.7	First day of No. 71. Nitrogen in feces = second day.
74	1885	.....do	.....do	51	59.5	1,010 cc. milk	1	6.1	5.5	1.0	— 0.4	Last day of No. 71. Nitrogen in feces and urine = mean of last day of period and following day.

TABLE 2.—*Experiments with a milk diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
75	1885	Rudenko	Mechanic (K.)	51	56.3	2,085 cc. milk	1	11.4	5.5	0.8	+5.1	Eleventh day of No. 71. Maximum milk diet.
76	1885	....do	Music teacher (Gh.)	28	75	1,461 cc. milk	7	7.5	9.7	1.5	—3.7	Nephritis diffusa.
77	1885	....do	....do	28	78	895 cc. milk	1	4.7	11.7	1.1	—8.1	First day of No. 76. Milk and nitrogen in milk = mean of first day of period and preceding day.
78	1885	....do	....do	28	74	2,100 cc. milk	1	10.6	9.8	1.9	—1.1	Last day of No. 76. Nitrogen in urine and feces = mean of last day of period and following day.
79	1888	Markov	Student	28	......	855 gm. soup, 369 gm. white bread, 151 gm. half white bread, 440 gm. meat; blackberries; 1,733 cc. tea.	3	29.9	25.7	2.3	+1.9	
80	1888	....do	....do	28	......	4,193 gm. milk	8	23.5	20.4	1.2	+1.9	
81	1888	....do	....do	28	......	1,006 gm. soup, 417 gm. white bread, 64 gm. half white bread, 323 gm. meat, 1,833 cc. tea.	3	25.5	21.2	2.0	+2.3	
82	1888	....do	Student	29	......	862 gm. soup, 358 gm. white bread, 56 gm. half white bread, 264 gm. meat; blackberries; 2,083 cc. tea.	3	23.6	16.7	2.4	+4.5	
83	1888	....do	....do	29	......	4,517 gm. milk	8	22.8	20.4	1.5	+0.9	
84	1888	....do	Student	29	......	699 gm. soup, 304 gm. white bread, 80 gm. half white bread, 275 gm. meat, 2,250 cc. tea.	3	22.5	19.5	2.4	+0.6	
85	1888	....do	Student	26	......	659 gm. soup. 299 gm. white bread, 213 gm. half white bread, 277 gm. meat; blackberries; 2,666 cc. tea.	3	24.3	19.0	2.1	+3.2	
86	1888	....do	....do	26	......	4.503 gm. milk	8	24.3	21.7	1.1	+1.5	
87	1888	....do	....do	26	......	347 gm. soup, 361 gm. white bread, 226 gm. half white bread, 294 gm. meat, 3.000 cc. tea.	3	23.9	23.6	1.4	−1.1	
88	1888	....do	....do	26	......	655 gm. soup, 294 gm. white bread, 108 gm. half white bread, 312 gm. meat; blackberries; 2,000 cc. tea.	3	21.2	19.3	1.5	−0.4	
89	1888	....do	....do	26	......	4,166 gm. milk	8	22.0	18.7	0.9	+2.4	

90	1888	.....do	.....do	26	....	619 gm. soup, 365 gm. white bread. 114 gm. half white bread, 202 gm. meat, 1,916 cc. tea.	3	17.3	20.0	0.9	−3.6
91	1888	.....do	Student	24	....	688 gm. soup, 100 white bread, 343 half white bread, 274 gm. meat; blackberries; 2,026 cc. tea.	3	25.1	17.5	2.6	+5.0
92	1888	.....do	.....do	24	....	2,728 gm. milk	6	16.3	17.6	1.0	−2.3
93	1888	.....do	.....do	24	....	1,006 gm. soup, 365 gm. white bread, 373 gm. half white bread, 303 gm. meat, 3,140 cc. tea.	3	30.0	20.6	1.8	+7.6
94	1888	.....do	Student	24	....	494 gm. soup, 221 gm. white bread. 284 gm. half white bread, 197 gm. meat; blackberries; 1,583 cc. tea.	3	18.5	14.5	2.8	+1.2
95	1888	.....do	.....do	24	....	3,728 gm. milk	8	22.2	18.7	1.3	+2.2
96	1888	.....do	.....do	24	....	380 gm. soup, 354 gm. white bread, 188 gm. half white bread, 250 gm. meat, 1,710 cc. tea.	3	23.8	17.3	2.0	+3.5
97	1889	Pransnitz	Laboratory servant	....	74	3 l. milk	3	13.3	19.0	1.1	—6.8
98	1892	Listov	Hospital nurse (Ch.).	21	59.3	2,833 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	22.1	18.3	1.3	+2.5
99	1892	.....do	.....do	21	59.5	3,083 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	23.0	19.0	1.5	+2.5
100	1892	.....do	Hospital nurse (R.).	24	50.2	2,583 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	20.8	15.2	1.1	+4.5
101	1892	.....do	.....do	24	50.9	2,575 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	20.4	17.2	1.5	+1.7
102	1892	.....do	Hospital nurse (Shch.).	22	64.1	2,892 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	22.4	20.3	1.3	+0.8
103	1892	.....do	.....do	22	....	3,083 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	23.0	20.1	1.3	+1.6
104	1892	.....do	.....do	22	61.8	2,700 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	21.5	18.7	2.0	+0.8
105	1892	.....do	.....do	22	61.0	2,750 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	21.3	21.3	1.7	—1.7
106	1892	.....do	Hospital nurse (A.).	19	52.1	2,900 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	20.8	14.7	1.5	+4.6
107	1892	.....do	.....do	19	52.2	3,267 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	22.1	17.7	1.1	+2.3
108	1892	.....do	Hospital nurse (V.).	19	48.3	2,300 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	17.9	13.8	1.5	+2.6
109	1892	.....do	.....do	19	48.3	2,793 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	19.7	15.7	1.1	+2.9
110	1892	.....do	Hospital nurse (K.).	19	77.1	3,333 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	21.7	20.1	1.4	+0.2
111	1892	.....do	.....do	19	77.5	3,825 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	24.3	21.4	1.9	+1.0
112	1892	.....do	Hospital nurse (S.).	19	67.2	3,750 gm. fresh milk, 400 gm. white bread, 50 gm. sugar.	3	23.6	21.3	1.9	+0.4
113	1892	.....do	.....do	19	67.3	3,817 gm. sterilized milk, 400 gm. white bread, 50 gm. sugar.	3	24.1	20.1	2.8	+1.2
114	1893	Magnus-Levy	Boy	16	57.5	3,500 cc. milk	3	16.4	18.7	0.8	—3.1
115	1893	.....do	.....do	16	....	2,177 gm. milk, 600 gm. bread, 88 gm. butter, 9.5 gm. sugar.	3	17.4	15.8	1.5	+0.1

TABLE 2.—*Experiments with a milk diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Weeks.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
116	1895	Lange	Child I	10	3.3	795 gm. milk	2	2.9	0.5	0.1	+2.3	
117	1895	....do	Child II	24	5.2	888 gm. milk	2	3.2	1.1	0.2	+1.9	
118	1895	....do	Child III	21	5.2	300 gm. milk, 600 gm. "water milk," 600 gm. rice gruel.	2	1.1	0.8	0.1	+0.2	
119	1895	....do	Child IV	4	2.8	578 gm. milk	2	2.1	0.7	0.2	+1.2	
120	1895	....do				640 gm. milk		2.3	0.8	0.2	+1.3	Average of Nos. 116–119.
121	1895	....do	Child V	3	3.1	645 gm. milk	2	2.3	0.7	0.1	+1.5	
122	1895	....do	Child VI	5	3.4	663 gm. milk	2	2.4	0.9	0.1	+1.4	
123	1885	....do	Child VII	1.5	2.9	588 gm. milk	2	2.1	0.7	0.1	+1.3	
123*a*	1895	....do	Child VIII	8	3.2	600 gm. milk	2	2.2	0.7	0.1	+0.4	
124	1895	....do	Child IX	17	5.5	865 gm. milk	2	3.1	1.0	0.1	+2.0	
125	1895	....do				572 gm. milk		2.4	0.8	0.1	+1.5	Average of Nos. 121–124.

Nos. 25–27. Ztschr. Biol., 15, pp. 130, 133. Nos. 28. 29. Ztschr. klin. Med., 7 sup., p. 18. Nos. 30–43. Ztschr. klin. Med., 7 sup., p. 14. Nos. 44–48. Vrach, 1880, p. 480. Nos. 49–53. Ztschr. Biol., 18, p. 489. Nos. 54–57. On the assimilation of the nitrogenous constituents of milk and the metabolism of nitrogen on an absolute milk diet. Inaug. Diss. (Russian), St. Petersburg, 1885, p. 66. Nos. 58–60. Ibid., p. 67. Nos. 61–64. Ibid., p. 68. Nos. 65–67. Ibid., p. 69. Nos. 68–71. Ibid., p. 70. Nos. 72–75. Ibid., p. 71. Nos. 76–78. Ibid., p. 72. Nos. 79–81. Metabolism of nitrogen by healthy persons on an absolute milk diet. Inaug. Diss. (Russian). St. Petersburg, 1888, p. 36. Nos. 82–84. Ibid., p. 38. Nos. 85–87. Ibid., p. 40. Nos. 88–90. Ibid., p. 42. Nos. 91–93. Ibid., p. 44. Nos. 94–96. Ibid., p. 46. No. 97. Ztschr. Biol., 25, p. 536. Nos. 98-101. The comparative assimilation and metabolism of nitrogen of sterilized and fresh milk by adult healthy persons. Inaug. Diss. (Russian), St. Petersburg, 1892, p. 45. Nos. 102–105. Ibid., p. 46. Nos. 106–109. Ibid., p. 47. Nos. 110–113. Ibid., p. 48. No. 114. Arch. Physiol., 53, p. 547. No. 115. Ibid., p. 551. Nos. 116–125. Jahrb. Kinderheilk., 39, p. 233.

Nos. 25–27 were made by Rubner in Munich in 1876, and form a series with Nos. 127–148, Table 3, and Nos. 413–417, Table 7. The object was to investigate the digestibility of milk. The subject was a professional man. The only food used was milk. The dry matter, nitrogen, fat, sugar, and ash in the milk were estimated from previous analyses by Voit. The feces were analyzed, the dry matter, nitrogen, ether extract, and ash being determined. No carbohydrates or protein were found in the feces. The milk feces could, of course, be easily separated.

The author remarks that the solid matter of milk is not as completely digested by adults as that of meat or eggs. This is largely due to the fact that the percentage of ash in the solid matter is larger in milk than in the other two articles. According to the author, the undigested organic matter from meat amounted to 4.1 to 4.7 per cent, from eggs 4.7 per cent, and from milk 5.4 per cent of the whole, not a very considerable difference. Young children digest milk more completely than adults. Forster[1] found that only 6.4 per cent of the solid matter of milk was undigested by a nursing infant. This may, perhaps, be explained by the fact that a considerable part of the ash of milk is composed of calcium salts and these would be more needed by the young organism for the formation of bones than in the case of an adult, and not so much would be left in the undigested residue to form insoluble salts of the fatty acids.

Nos. 28, 29 were made by Hoffmann in Dorpat in 1884 (?). The object was to investigate metabolism with an absolute milk diet. The subject was a physician in good health. He changed his ordinary diet to an absolute milk diet gradually. It was impossible for him to consume over 3 liters per day. The amount of protein in the milk and the nitrogen in the urine and feces were determined.

No. 28 was made in the winter, and there was a considerable loss of nitrogen. No. 29 was made in the summer, and the loss of nitrogen was not so great.

The experiments and opinions of other authors are quoted. The great value of milk as a diet for the sick is insisted on.

Nos. 30–43 were made by Slatkowsky in St. Petersburg in 1881 (?). The object was to study the influence of profuse sweating on the assimilation of milk. The subjects were 2 men and 1 woman. The only food consumed was milk. Large quantities were taken daily without any difficulty or bad results. The nitrogen in food (?), urine, and feces was determined. In Nos. 28–35 a period of 3 days on milk diet under ordinary conditions was followed by a 2-day period in which profuse perspiration was induced. This seemed to increase the amount of nitrogen absorbed. It is possible, however, that this might be due to the fact that the organism became used to the milk diet. To settle this point the conditions were reversed in Nos. 36–39, and in Nos. 40–43 milk diet was followed for 5 days and perspiration was not induced. It was found that when a milk diet was followed for some time there was an increased assimilation of nitrogen.

Nos. 44–48 were made by Laptchinsky in 1880 (?). The object was to investigate the value of a milk diet. The subjects were 3 healthy individuals and 2 who were recovering from an illness. The food consisted of milk and a very little bread or pastry (*Gebäck*).

The subjects of Nos. 44, 45 did not change in weight during the experiment. The subject of No. 46 lost 4 kilograms in 6 days, the subject of No. 47 lost 520 grams in 6 days, and the subject of No. 48 gained 550 grams in 5 days.

Nos. 49–53. See Nos. 462–473, Table 7.

Nos. 54–78 were made by Rudenko in St. Petersburg in 1885, and form a series with Nos. 2621–2635 with dogs. The object was to study the metabolism and assimilation of nitrogen on a milk diet.

Eight series of experiments were made with men and women. In the first two series (Nos. 54–57) the special object of study was the metabolism of nitrogen at the time of the transition from the customary mixed diet to the milk diet. The author

[1] Ztschr. Biol., 15 (1879), p. 135.

himself, who was a healthy person, was the subject of Nos. 54, 55. The subject of Nos. 56, 57 was a very corpulent man, though otherwise in good health.

In the last six series the subjects were suffering from various diseases. They underwent a so-called milk treatment. The subjects of Nos. 58–75 at first drank 4 glasses of whole milk a day in 8 portions. This quantity was increased a half glass each day until 10 to 12 glasses per day were consumed. The quantity of milk was then gradually diminished and solid food taken in its place. The subject of Nos. 76–78 drank as much milk as he wished.

It was the usual plan in these experiments to begin to collect the urine and feces one day after the test commenced and to continue it one day after the test ended.

The nitrogen in the food, urine, and feces was determined by the Kjeldahl method except in No. 75, in which the Kjeldahl-Borodin method was used.

The author gives the results of Nos. 54–57 as follows: During the transition from the mixed to the milk diet there was a marked decrease in weight. However, this was not due to an excretion of the products of the cleavage of protein, but must be ascribed to a loss of water from the tissues of the body. The outgo of nitrogen in the urine was increased.

The results of Nos. 58–78 are summed up as follows: The weight of the body decreased in every case, considering the test as a whole. The decrease was more striking at the beginning of the milk treatment. As the treatment proceeded the loss of weight was less, and sometimes there was a slight gain. The outgo of nitrogen exceeded the income in all cases at the beginning of the milk period. As the milk period progressed, the difference between the income and outgo of nitrogen became less. In the majority of cases nitrogen equilibrium was reached when 2,000 cubic centimeters of milk per day was consumed. The assimilation of nitrogen of milk varied within wide limits. In general the quantity of urine excreted as compared with the quantity of milk consumed was larger during the first days of the period and less later on.

The excretion of urea, phosphates, and sulphur is also discussed.

Nos. 79–96 were made by Markov, in the laboratory of Koshkakov, in St Petersburg, in 1888. The object was to study the metabolism of nitrogen in healthy persons on an absolute milk diet. Seven series of experiments carried out at the clinical hospital of the Military Medical Academy at St. Petersburg are described. The subjects were 6 medical students. The experiments were usually of 14 days duration, and were divided into three periods, the first and third on a mixed diet and the second on an exclusive milk diet. Complete data were not given for all the periods. The food was uniform in all cases, consisting in the mixed diet of soup, with an admixture of pearl barley; a piece of fried meat, from which the bones, tendon, and as much as possible of the fat were removed; boiled milk, white bread, and tea.

Before the beginning and also at the end of each experiment, in order to identify the feces corresponding to the period of the experiment, the subjects were given stewed blackberries.

The occupation of the subjects in the first four experiments was intense intellectual work, such as is required in the preparation for the final examinations, and in the last two experiments attending lectures and reading. The nitrogen in food, urine, and feces, was determined. The author sums up the results of his experiments as follows: The metabolism of nitrogen in healthy persons on an absolute milk diet was regulated by the quantity of milk taken, being lower when much milk was consumed and higher when less milk was consumed. The percentage of nitrogen of urea increased and that of nitrogen of extractives decreased in the urine.

Under the influence of an exclusive milk diet the quantity of uric acid decreased in a marked degree and the power of assimilation increased.

The influence of an absolute milk diet extended also over the following mixed diet period.

On comparing the figures relating to the milk diet with those relating to the mixed diet in the first period, it was evident that on the milk diet there was less nitrogen

digested and also less excreted through the urine, but that the amount of urea was larger by 8 per cent and the amount of extractives correspondingly smaller. Consequently the metabolism on the milk diet was lower in quantity but better in quality than on the mixed diet in the first period.

In the third period (mixed diet) the quantity of the nitrogen digested was less than in the first period but more than in the milk period, and the quantity of nitrogen excreted was 2.8 per cent less than in the first period and 0.2 per cent less than in the second period, while the urea was 8.8 per cent more than in the first period and 0.8 per cent more than in the second. Hence it follows that the metabolism in the third period was lower in quantity but better in quality than in the first and second periods.

No. 97. This experiment was made by Prausnitz in the laboratory of the Physiological Institute, in Munich, in 1889. The object was to investigate the digestibility of milk. The subject was the laboratory servant who had been so often used in Rubner's experiments. The only food was milk. This was purchased in quantity, thoroughly mixed, put into little flasks, and sterilized by heating for two hours in a Koch steam sterilizer. The milk was kept in the flasks on ice and slightly warmed before it was used. The food, urine, and feces were analyzed.

The conclusion is reached that milk is one of the most useful, convenient, and economical sources of protein.

Nos. 98–113 were made by Listov in St. Petersburg in 1892. The object was to compare the metabolism and assimilation of nitrogen when raw and sterilized milk were consumed by healthy adult persons. Eight experiments are described, each covering 6 days, divided into 2 equal periods. In one period raw milk was consumed, in the other sterilized milk. In addition white bread and sugar were consumed. The milk was sterilized with Koch's apparatus for 1¾ hours, at a temperature of 100 to 110°. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: The assimilation of the nitrogenous constituents of sterilized milk was somewhat less than raw milk. The mean assimilation of the former was 91.8 per cent and of the latter 93.6 per cent. The quantitative metabolism in each case was practically the same, being 90.4 per cent in the sterilized milk and 91.4 per cent in the raw milk. Sterilized milk contains no peptones. The amount of nitrogenous constituents assimilated from the diet followed in the present experiment is somewhat less than on an absolute milk diet, as shown by Markov's experiments, Nos. 79–96.

Nos. 114, 115 were made by Magnus-Levy in the laboratory of the Agricultural Institute in Berlin, in 1891, and form a series with Nos. 281–284, Table 4. The object was to investigate the digestibility of milk and bread, and by comparing the results with those previously obtained to judge of the effect of alcohol on metabolism.

The subject was a boy 16 years old who had never used alcoholic drinks, and none were consumed during these two tests. In No. 114 the diet was exclusively milk. No bad effects were noticed. In No. 115 the diet consisted of milk, bread, butter, and sugar.

The food, urine, and feces were analyzed.

The following conclusions are drawn: Slight differences in the assimilation of nitrogen and fat are noticed in the cases of individuals who use alcohol and those who are total abstainers. On the whole, however, assimilation is as good in one case as the other, for the carbohydrates which furnish most of the energy to the organism are almost completely assimilated in both cases, provided they are consumed in a suitable form and in not too great quantity.

Nos. 116–125 were made by Lange at the Medical Institute at the University of Leipsic, in 1895. The object was to study the metabolism of nursing children when fed cow's milk. The subjects were young children. The food consisted of a mixture of two parts cow's milk and one part of a 12.3 per cent milk-sugar solution. This

was sterilized by Soxhlet's method. The urine was collected by Epstein's method. The nitrogen in the food, urine, and feces was determined.

The following conclusions were reached: The nitrogen of cow's milk when it is properly prepared (diluted with milk-sugar solution and sterilized) is almost as thoroughly assimilated as that of mother's milk. The dry matter in the feces is about twice as great in the case of a dyspeptic subject as with a healthy child, and the amount of nitrogen in the feces is also greater, though the percentage content is less than when the functions of the stomach are normal. The nursing child fed with milk is not in nitrogen equilibrium, but retains large quantities of nitrogen, usually more than corresponds to the gain in weight. This discrepancy can best be explained by the fact that the child's body grows with great rapidity and retains large quantities of nitrogen for the formation of new cells, though the author does not question Camerer and von Noorden's theory of increased intestinal work, or Biedert's theory of the formation of free nitrogen by intestinal bacteria, which might account for the excess.

A test by practically the same methods was also made by the author with a dog (see No. 2745, Table 28).

EXPERIMENTS WITH BREAD AND OTHER SINGLE FOOD MATERIALS.

In Table 3 are included 115 tests with men and 3 with women in which the diet consisted of meat, eggs, cheese, bread, or other single food materials. The bread was of various kinds, including that made from rye, fine wheat flour, and whole wheat flour. The majority of the experiments quoted were studies of digestibility in which the balance of income and outgo of nitrogen was also determined. In some cases in which vegetables were consumed the experiments can hardly be considered normal, since the total amount of food consumed was insufficient for the needs of the organism.

Experiments on the influence of a single food material are of two general types—either the particular food may be the only food consumed, or it may be the varying constituent in an otherwise uniform diet. As pointed out in discussing a milk diet, there are practical difficulties in conducting experiments with a diet consisting of a single food. The monotonous diet may become repulsive and derange the digestive functions more or less. The experimental period must be long enough to eliminate the influence of the preceding diet, but not long enough to derange normal functions. It is often difficult to obtain protein, fat, and carbohydrates in the proper proportions when only one food is eaten. For instance, if meat, eggs, or other material with a high nitrogen content is consumed in sufficient quantity to furnish the requisite energy the amount of protein would be considerably in excess of the amount which dietary standards call for. When small amounts of other foods are consumed with large quantities of the special food studied, it is uncertain how far digestibility and assimilation are influenced.

Experiments in which single foods have been studied with diseased subjects will be found in Tables 17–23.

TABLE 3.—*Experiments with bread and other single food materials.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
126	1842	Lehmann	Observer			32 eggs	4	30.2	25.6	(0.6)	+ 4.0	
127	1879	Rubner	Medical student	22	72	884 gm. meat	3	48.8	47.2	1.2	+ 0.4	
128	1879	do	Man	24	46	948.1 gm. eggs	2	20.7	21.9	0.6	— 1.8	
129	1879	do	Medical student	22	72	738 gm. meat	3	39.8	37.6	1.1	+ 1.1	
130	1879	do	Laboratory servant.	43	72	2,050 gm. milk, 218 gm. cheese	1	23.5	24.3	0.7	— 1.5	
131	1879	do	do	43		2,209 gm. milk, 517 gm. cheese	1	38.9	25.3	1.9	+11.7	
132	1879	do	Medical student	22		865.3 gm. polenta (750 gm. maize meal, 51.1 gm. butter, 12.7 gm. cheese, 36.2 gm. meat extract, 15.4 gm. salt), 1,250 cc. beer.	2	14.7	15.2	2.3	— 2.8	
133	1879	do	do	23		638 gm. rice, 121.8 gm. fat, meat extract, salt.	2	16.4	11.6	2.1	+ 2.7	
134	1879	do	Soldier			3,077.6 gm. potatoes, 53.8 gm. salt, 28.6 gm. butter or 32 gm. oil and vinegar.	3	11.5	3.7	8.8	— 1.0	
135	1879	do	Laboratory servant.	44		689 gm. white bread	3	7.6	11.2	2.0	— 5.6	
136	1879	do	do	44		1,185 gm. white bread	3	13.0	12.5	2.4	— 1.9	
137	1879	do	do	44		743 gm. spätzeln	3	11.9	14.0	2.3	— 4.4	
138	1879	do	do	44		1,360 gm. black bread	2	13.3	12.6	4.3	— 3.6	
139	1879	do	do	44		695 gm. macaroni noodles	2	10.9	16.0	1.9	— 7.0	
140	1879	do	do	44		695 gm. macaroni and wheat gluten noodles.	2	22.6	17.9	2.5	+ 2.2	
141	1879	Breuer (reported by Rubner).	Observer			3,831 gm. Savoy cabbage, 65.5 gm. fat, 21.7 gm. salt.	3	13.2	17.6	2.4	— 6.8	
142	1879	do	do			2,566 gm. carrots, 41.9 gm. fat, 18.1 gm. salt.	2	6.5	12.5	2.5	— 8.5	
143	1880	Rubner	Laboratory servant.	44		959.8 gm. peas. 1,000 cc. beer	2	32.7	21.5	9.1	+ 2.1	
144	1880	do	do	44		600 gm. peas. 1,000 cc. beer	2	20.4	17.6	3.6	— 0.8	
145	1880	do	Medical student	22		540.2 gm. green beans, 53.4 gm. butter, 7.6 gm. salt.	2	1.4	10.7	0.7	—10.0	
146	1880	do	Laboratory servant.			898 gm. bread from finest wheat flour, 1,500 cc. beer.	3	10.2	13.6	2.2	— 5.6	
147	1880	do	do			882 gm. bread from medium flour, 1,500 cc. beer, 400 cc. water.	3	13.2	14.2	3.2	— 4.2	
148	1880	do	do			989 gm. bread from whole wheat meal, 1,500 cc. beer, 750 cc. water.	3	12.5	13.0	3.8	— 4.3	
149	1886	Solntzev	Prisoner (L.)		70.5	1,050 gm. canned mutton, 975 cc. water, 11 gm. salt.	1	64.1	31.0	7.4	+25.7	
150	1886	do	do		70.5	1,336 gm. cooked mutton, 1,625 gm. water, 18 gm. salt.	1	56.4	50.5	3.9	+ 2.0	
151	1886	do	Prisoner (P.)		80.5	1,394 gm. canned mutton, 2,400 gm. water, 13 gm. salt.	1	84.1	62.4	4.0	+17.7	

TABLE 3.—*Experiments with bread and other single food materials*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
152	1886	Solntzev	Prisoner (P.)		80.5	1,166 gm. cooked mutton, 1,500 gm. water, 14 gm. salt.	1	63.4	43.4	4.8	+15.2	
153	1886	do	Prisoner (B.)		80.5	1,643 gm. canned mutton, 4,500 gm. water, — gm. salt.	1	75.2	65.3	8.6	+ 1.3	
154	1886	do	do		80.5	1,671 gm. cooked mutton, 3,000 gm. water, 39 gm. salt.	1	90.9	58.5	5.0	+27.4	
155	1886	do	Prisoner (L.)		67	885 gm. canned beef	1	43.9	27.8	7.5	+ 8.6	
156	1886	do	do		66.5	715 gm. cooked beef	1	31.9	25.6	4.6	+ 1.7	
157	1886	do	Prisoner (D.)		61.6	1,185 gm. canned beef	1	60.1	28.0	7.8	+24.3	
158	1886	do	do		62	1,252 gm. cooked beef	1	55.3	33.7	2.9	+18.7	
159	1886	do	Prisoner (V.)		76.5	975 gm. canned beef	1	47.0	33.0	3.4	+10.6	
160	1886	do	do		75.2	1,070 gm. cooked beef	1	46.7	39.5	2.3	+ 4.9	
161	1886	do	Prisoner (D.)		63.4	1,098 gm. black bread, 1,800 gm. water, 24 gm. salt.	1	18.7	13.7	7.3	— 2.3	
162	1886	do	Prisoner (L.)		70.6	1,405 gm. black bread, 650 gm. water, 11 gm. salt.	1	23.9	18.4	6.6	— 1.1	
163	1886	do	Prisoner (V.)		76.3	1,408 gm. black bread, 1,575 gm. water, 14 gm. salt.	1	23.9	18.5	8.2	— 2.8	
164	1886	do	Prisoner (P.)		81.5	1,529 gm. black bread, 1,200 gm. water, 11 gm. salt.	1	23.4	17.7	8.3	— 2.6	
165	1886	do	Prisoner (B.)		75	2,538 gm. black bread, 3,300 gm. water, 44 gm. salt.	1	45.2	24.4	8.2	+12.6	
166	1886	do	Prisoner (L.)		69.6	755 gm. cooked beef, 877 gm. bread, 1,300 gm. water, 16 gm. salt.	1	53.2	33.6	5.5	+14.1	
167	1886	do	Prisoner (D.)		61.5	585 gm. bread, 2,000 gm. water, 800 gm. canned beef, 14 gm. salt.	1	57.3	36.3	8.9	+12.1	
168	1886	do	do		62.8	686 gm. bread, 1,200 gm. water, 757 gm. cooked beef, 16 gm. salt.	1	49.8	32.2	5.9	+11.7	
169	1886	do	Prisoner (V.)		76.4	928 gm. bread, 2,475 gm. water, 1,036 gm. canned beef, 16 gm. salt.	1	77.6	39.2	7.4	+31.0	
170	1886	do	do		75.6	1,004 gm. bread, 2,475 gm. water, 1,181 gm. cooked beef, 19 gm. salt.	1	76.4	45.5	5.4	+25.5	
171	1886	do	Prisoner (L.)		70.3	843 gm. bread, 1,950 gm. water, 887 gm. canned mutton, 8 gm. salt.	1	54.3	39.1	14.7	+ 0.5	
172	1886	do	do		69.4	943 gm. bread, 1,300 gm. water, 815 gm. cooked mutton, 15 gm. salt.	1	60.9	38.9	8.8	+13.2	
173	1886	do	Prisoner (B.)		75.1	1,783 gm. bread, 5,400 gm. water, 1,000 gm. canned mutton, 30 gm. salt.	1	75.7	50.1	6.9	+18.7	

174	1886	....do	....do	....	73.5	1,190 gm. bread, 3,300 gm. water, 1,223 gm. cooked mutton, 55 gm. salt.	1	86.6	58.8	5.8	+32.0	
175	1886	....do	Prisoner (P.)	....	82.3	1,079 gm. bread, — gm. water, 672 gm. canned mutton, — gm. salt.	1	43.5	22.5	5.5	+15.5	
176	1886	....do	....do	....	81.6	949 gm. bread, 1,800 gm. water, 895 gm. canned mutton, 11 gm. salt.	1	56.4	41.1	5.8	+ 9.5	
177	1886	....do	....do	....	81.5	1,202 gm. bread, 1,200 gm. water, 965 gm. cooked mutton, 11 gm. salt.	1	61.1	42.5	4.3	+14.3	
178	1887	Kurcheninov	Physician (Gh.)	42	58.1	747 cc. bouillon, 616 gm. white bread, 64 gm. butter, 385 gm. cutlet, 11 gm. salt, 160 gm. sugar, 2,130 cc. water and tea, 30 gm. blackberries (1 day).	3	28.7	23.9	2.8	+ 2.0	Mixed diet.
179	1887	....do	....do	42	57.9	1,859 gm. thin gruel, 660 cc. bouillon, 57 gm. butter, 14 gm. salt, 82 gm. sugar, 30 gm. blackberries (1 day), 687 cc. water and tea.	3	6.0	8.6	3.7	— 6.3	Millet-meal diet (thin gruel).
180	1887	....do	....do	42	57.2	1,194 gm. thick gruel, 560 cc. bouillon, 60 gm. butter, 16 gm. salt, 108 gm. sugar, 30 gm. blackberries (1 day), 1,060 cc. water and tea.	3	7.9	6.3	4.1	— 2.5	Millet-meal diet (thick gruel).
181	1887	....do	....do	42	56.8	560 cc. bouillon, 473 gm. white bread, 73 gm. butter, 389 gm. cutlet, 9 gm. salt, 142 gm. sugar, 30 gm. blackberries (1 day), 1,760 cc. water and tea.	3	26.6	20.9	2.2	+ 3.5	Mixed diet.
182	1887	....do	Physician (K.)	28	60.3	517 cc. bouillon, 359 gm. bread, 40 gm. butter, 311 gm. cutlet, 10 gm. salt, 117 gm. sugar, 30 gm. blackberries (1 day), 1,813 cc. water and tea.	3	21.0	20.4	2.0	— 1.4	Do.
183	1887	....do	....do	28	60.4	1,201 gm. thin gruel, 660 cc. bouillon, 47 gm. butter, 12 gm. salt, 83 gm. sugar, 30 gm. blackberries (1 day), 1,040 cc. water and tea.	3	4.0	9.1	2.0	— 7.1	Millet-meal diet (thin gruel).
184	1887	....do	....do	28	58.7	480 cc. bouillon, 300 gm. bread, 50 gm. butter, 335 gm. cutlet, 10 gm. salt, 92 gm. sugar, 30 gm. blackberries (1 day), 1,103 cc. water and tea.	3	20.9	16.0	2.2	+ 2.7	Mixed diet.
185	1887	....do	Physician's assistant (S.).	20	54.2	349 gm. gruel, 953 cc. bouillon, 471 gm. bread, 73 gm. butter, 390 gm. cutlet, 19 gm. salt, 97 gm. sugar, 30 gm. blackberries (1 day), 2,340 cc. water and tea.	3	25.1	20.2	2.7	+ 2.2	Do.
186	1887	....do	....do	20	54.5	1,719 gm. thin gruel, 693 cc. bouillon, 80 gm. butter, 22 gm. salt, 104 gm. sugar, 30 gm. blackberries (1 day), 2,647 cc. water and tea.	3	2.7	8.6	2.9	— 8.8	Millet-meal diet (thin gruel).
187	1887	....do	....do	20	54.4	1,221 gm. thick gruel, 780 cc. bouillon, 80 gm. butter, 29 gm. salt, 103 gm. sugar, 30 gm. blackberries (1 day), 2,600 cc. water and tea.	3	2.2	6.0	4.5	— 8.3	Millet-meal diet (thick gruel).
188	1887	....do	....do	20	54.4	321 gm. gruel (2 days), 780 cc. bouillon, 600 gm. bread, 82 gm. butter, 370 gm. cutlet, 18 gm. salt, 100 gm. sugar, 30 gm. blackberries (1 day), 2,617 cc. water and tea.	3	25.6	19.0	2.2	+ 4.4	Mixed diet.

TABLE 3.—*Experiments with bread and other single food materials*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
189	1887	Kurcheninov	Servant (V.)	25	56.9	349 gm. gruel, 1,127 cc. bouillon, 516 gm. bread, 79 gm. butter, 386 gm. cutlet, 31 gm. salt, 161 gm. sugar, 30 gm. blackberries (1 day), 2,513 cc. water and tea.	3	28.1	22.4	2.7	+ 3.0	Mixed diet.
190	1887	....do	....do	25	56.6	1,615 gm. thin gruel, 867 cc. bouillon, 130 gm. butter, 27 gm. salt, 154 gm. sugar, 30 gm. blackberries (1 day), 2,733 cc. water and tea.	3	5.6	8.9	3.2	— 6.5	Millet-meal diet (thin gruel).
191	1887	....do	....do	25	56.6	809 gm. thick gruel, 693 cc. bouillon, 130 gm. butter, 25 gm. salt, 153 gm. sugar, 30 gm. blackberries (1 day), 2,080 cc. water and tea.	3	4.7	5.7	2.6	— 3.6	Millet-meal diet (thick gruel).
192	1887	....do	....do	25	57.8	Food similar to No. 189	3	29.5	16.1	2.8	+10.6	Mixed diet.
193	1887	....do	Servant (S.)	38	71.5	Food similar to No. 189	3	28.4	20.1	2.4	+ 5.9	Do.
193a	1887	....do	....do	38	73.6	1,745 gm. thin gruel, 1,040 cc. bouillon, 130 gm. butter, 19 gm. salt, 97 gm. sugar, 30 gm. blackberries (1 day), 2,340 cc. water and tea.	3	5.9	9.2	3.7	— 7.0	Millet-meal diet (thin gruel).
193b	1887	....do	....do	38	73.7	1,229 gm. thick gruel, 867 cc. bouillon, 130 gm. butter, 25 gm. salt, 103 gm. sugar, 30 gm. blackberries (1 day), 1,733 cc. water and tea.	3	6.9	5.7	3.5	— 2.3	Millet-meal diet (thick gruel).
194	1887	....do	....do	38	73	321 gm. gruel, 693 cc. bouillon, 401 gm. bread, 92 gm. butter, 368 gm. cutlet, 21 gm. salt, 100 gm. sugar, 30 gm. blackberries (1 day), 2,097 cc. water and tea.	3	24.3	10.7	2.6	+11.0	Mixed diet.
195	1888	Atwater	Medical student	....	79	1,549 gm. fish, 30.5 gm. butter, 700 gm. wine, 1,250 gm. beer, 200 gm. coffee (2 days), salt, vinegar, etc.	3	45.6	44.1	0.9	+ 0.6	
196	1888	....do	....do	....	79	1,200 lean beef, 30 gm. butter, 367 gm. wine (2 days), 1,250 gm. beer, 200 gm. coffee, 10.5 gm. salt.	3	38.5	37.2	1.0	+ 0.3	
197	1889	Malakhovski	Man (S.)	19	60.7	1,100 gm. soup, 800 gm. blackberries, 60 gm. potassium albuminates, 800 gm. bread, 3,850 cc. tea and water.	2	22.7	17.3	6.8	— 1.4	Potassium albumen powder and vegetable food.

198	1889	.....do	Man(A.)	19	63.8	1,128 gm. soup, 749 gm. blackberries, 60 gm. potassium albumen powder. 800 gm. bread, 1,050 cc. tea and water.	2	23.5	20.3	4.5	— 1.3	Do.
199	1889	.....do	Man (P.)	27	55.9	1,430 gm. soup, 840 gm. blackberries, 60 gm. potassium albumen powder, 800 gm. bread, 3,150 cc. tea and water.	2	22.8	15.6	7.3	— 0.1	Do.
200	1889	.....do	Man (A.)	31	64.5	1,315 gm. soup, 820 gm. blackberries, 60 gm. potassium albumen powder 800 gm. bread, 3,500 cc. tea and water.	2	22.9	18.6	4.6	— 0.3	Do.
201	1889	.....do	Man (P.)	20	60	1,413 gm. soup, 900 gm. blackberries, 60 gm. sodium albumen powder, 800 gm. bread, 3,263 cc. tea and water.	3	22.7	14.8	4.2	+ 3.7	Sodium albumen powder and vegetable food.
202	1889	.....do	Man (A.)	18	50.5	1,329 gm. soup, 853 gm. blackberries, 60 gm. sodium albumen powder, — gm. bread, 2,800 cc. tea and water.	3	22.5	17.5	4.9	+ 0.1	Do.
203	1889	.....do	.....do	30	63.9	1,305 gm. soup, 767 gm. blackberries, 60 gm. sodium albumen powder, 800 gm. bread, 937 cc. tea and water.	3	22.5	14.3	5.9	+ 2.3	Do.
204	1889	.....do	Man (T.)	22	51.7	783 gm. soup, 533 gm. bread, 353 gm. alcohol albuminates, 2,333 cc. tea and water.	3	12.2	8.8	3.0	+ 0.4	Albuminates soaked in alcohol and vegetable food.
205	1889	.....do	Man (K.)	22	55.6	797 gm. soup, 533 gm. bread, 353 gm. alcohol albuminates, 1,167 cc. tea and water.	3	12.1	9.5	2.9	— 0.3	Do.
206	1889	.....do	Physician (M.)	42	75.6	993 gm. soup, 724 gm. bread, 519 gm. alcohol albuminates, 12 gm. butter, 730 cc. tea and water.	3	17.2	14.3	2.6	+ 0.3	Do.
207	1889	.....do	.....do	42	75.6	370 gm. sodium albumen gruel, 39 gm. butter, 719 gm. bread, 5 gm. salt, 1,246 cc. tea and water.	3	16.9	15.2	4.6	— 2.9	Sodium albumen gruel, butter, bread, and salt.
208	1889	.....do	Man (L.)	24	64.8	458 gm. sodium albumen gruel, 39 gm. butter, 868 gm. bread, 5 gm. salt, 1,826 cc. tea and water.	3	18.7	13.0	4.1	+ 1.6	Do.
209	1889	.....do	Man (T.)	28	57.9	568 gm. potassium albumen gruel, 37 gm. butter, 966 gm. bread, 5 gm. salt, 2,420 cc. tea and water.	3	20.0	18.1	3.5	— 1.6	Potassium albumen gruel, butter, bread, and salt.
210	1889	.....do	Man (P.)	28	60.4	1,077 gm. soup, 773 gm. buckwheat porridge, 763 gm. bread, 200 gm. meat, 1,300 cc. tea and water.	3	23.1	13.3	3.4	+ 6.4	Mixed diet.
211	1889	.....do	Man (A.)	30	67.6	1,177 gm. soup, 707 gm. buckwheat porridge, 800 gm. bread, 200 gm. meat, 700 cc. tea and water.	3	23.5	13.7	3.1	+ 6.7	Do.
212	1889	.....do	Man (A.)	18	50.5	840 gm. soup, 687 gm. buckwheat porridge, 709 gm. bread, 200 gm. meat, 1,167 cc. tea and water.	3	22.3	15.6	3.8	+ 2.9	Do.
213	1889	.....do	Man (P.)	20	64.3	976 gm. soup, 863 gm. buckwheat porridge, 800 gm. bread, 1,633 cc. tea and water.	3	15.1	10.1	3.6	+ 1.4	Vegetable diet.
214	1889	.....do	Man (A.)	30	67.8	976 gm. soup, 863 gm. buckwheat porridge, 833 gm. bread, 933 cc. tea and water.	3	15.5	10.0	5.2	+ 0.3	Do.
215	1889	.....do	Man (A.)	18	50.6	867 gm. soup, 793 gm. buckwheat porridge, 808 gm. bread, 1,287 cc. tea and water.	3	15.1	11.0	4.6	— 0.5	Do.

TABLE 3.—*Experiments with bread and other single food materials*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (−).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
216	1889	Kuznetsov	Observer	37	52.5	421 gm. bread, 360 gm. meat, 373 gm. soup, 1,871 gm. tea, 100 gm. sugar.	10	20.8	19.1	1.6	+0.1	In Nos. 216-230 a little gravy, etc., was consumed also. Its nitrogen content is included in the nitrogen consumed.
217	1889	do	do	37	53.1	515 gm. bread, 90 gm. potassium albumen powder, 2,506 gm. tea, 98 gm. sugar.	7	20.8	18.5	2.2	+0.1	
218	1889	do	do	37	52.9	515 gm. bread, 350 gm. meat, 400 gm. soup, 1,850 gm. tea, 100 gm. sugar.	6	22.6	19.9	1.8	+0.9	
219	1889	do	do	37	53	515 gm. bread, 90 gm. potassium albumen powder, 2,506 gm. tea, 100 gm. sugar.	4	20.6	18.1	2.2	+0.3	
220	1889	do	do	37	54	410 gm. bread, 66 gm. potassium albumen powder.	23	17.2	14.4	2.5	+0.3	
221	1889	do	do	37	53.9	400 gm. bread, 287 gm. meat	5	18.0	15.1	2.1	+0.8	
222	1889	do	do	37	53.6	— gm. bread, 577 gm. albumen jelly, 1,954 gm. tea, 130 gm. sugar.	7	15.9	13.6	2.2	+0.1	
223	1889	do	do	37	53.5	407 gm. bread, 225 gm. meat, 470 gm. soup, 1,792 gm. tea, 130 gm. sugar.	4	16.7	14.5	2.1	+0.1	
224	1889	do	do	37	54	456 gm. bread, 240 gm. meat, 310 gm. soup, 1,896 gm. tea, 90 gm. sugar.	7	16.8	14.5	1.5	+0.8	
225	1889	do	do	37	54.2	454 gm. bread, — gm. sodium albumen powder, 1,736 gm. tea, 120 gm sugar.	6	16.8	14.5	1.7	+0.6	
226	1889	do	Midwife	34	54	312 gm. bread, 150 gm. meat, 400 gm. soup, 2,032 gm. tea, 45 gm. sugar.	7	11.8	11.5	2.0	—1.7	
227	1889	do	do	34	54.2	309 gm. bread, 150 gm. meat, 400 gm. soup, 1,994 gm. tea, 45 gm. sugar.	5	11.8	11.3	1.5	—1.0	Last 5 days of No. 226.
228	1889	do	do	34	52	302 gm. bread, 38 gm. sodium albumen powder, 2,605 gm. tea, 45 gm. sugar.	7	10.6	12.3	1.4	—3.1	
229	1889	do	Observer	37	53	415 gm. bread, 300 gm. meat, 400 gm. soup, 2,033 gm. tea, 130 gm. sugar.	4	19.3	17.4	1.7	+0.2	
230	1889	do	do	37	53.4	415 gm. bread, 73 gm. potassium albumen powder, 2,582 gm. tea, 104 gm. sugar.	4	17.2	15.2	1.9	+0.1	
231	1890	Prausnitz	Laboratory servant.			500 gm. beans, 28.6 gm. fat, 17.3 gm. flour, 17 gm. salt, 6.6 gm. vinegar.	3	17.9	14.7	5.4	—2.2	
232	1890-91	Hultgren and Landergren.	Observer (H.)	22½	61	170 gm. rye bread, 111 gm. margarin, 315 cc. red wine, 220 cc. water.	2	4.3	10.3	2.0	—8.0	

233	1890–91	.....do	.....do	22½	61	251 gm. rye bread, 131 gm. margarin, 830 cc. beer.	2	4.7	8.7	2.2	—6.2
234	1890–91	.....do	Observer (L.).......	22	79	337 gm. rye bread, 154 gm. margarin, 830 cc. beer and coffee, 100 cc. Swedish punch (1 day).	2	6.3	11.1	2.8	—7.6
235	1890–91	.....do	Observer (H.).......	22½	....	254 gm. rye bread, 153 gm. butter, 830 cc. beer and coffee, 100 cc. Swedish punch (1 day).	2	4.7	9.3	1.8	—6.4
236	1890–91	.....do	Observer (L.).......	22	....	320 gm. rye bread, 179 gm. butter, 915 cc. beer, coffee, and punch.	2	6.1	11.9	3.0	—8.8
237	1892	Tanignti........	Servant.............	....	....	Rice, meat extract	2	11.1	9.4		+1.7
238	1892	.....do	.....do	....	....	Rice, takaun (salted turnips)..................	4	10.3	11.1		—0.8
239	1892	.....do	.....do	....	....	Rice, miso..................................	1	13.0	9.8		+4.2
240	1896	Solomin.........	Laboratory servant.	27	76.1	933 gm. tripe, 450 gm. bread, 50.7 gm. butter, 37.2 gm. flour, 10.3 gm. salt, 1,000 cc. beer.	3	23.7	18.4	2.6	+2.7
241	1896	.....do	.....do	27	75.6	800 gm. meat, 450 gm. bread, 57.3 gm. butter, 32.1 gm. flour, 9.6 gm. salt, 1,000 cc. beer.	3	28.5	23.6	2.7	+2.2

No. 126. Jour. prakt. Chem., 27, p. 259. No. 127. Ztschr. Biol., 15, p. 121. No. 128. Ibid., p. 127. No. 129. Ibid., p. 125. No. 130. Ibid., p. 138. No. 131. Ibid., p. 139. No. 132. Ibid., p. 140. No. 133. Ibid., p. 144. No. 134. Ibid., p. 146. No. 135. Ibid., p. 150. No. 136. Ibid., p. 152. No. 137. Ibid., p. 155. No. 138. Ibid., p. 157. No. 139. Ibid., p. 160. No. 140. Ibid., p. 163. No. 141. Ibid., p. 167. No. 142. Ibid., p. 169 No. 143. Ztschr. Biol., 16, p. 121. No. 144. Ibid., p. 123. No. 145. Ibid., p. 127. No. 146. Ztschr. Biol., 19, p. 57. No. 147. Ibid., p. 61. No. 148. Ibid., p. 65. Nos. 149–165. Preserved food for armies. Meat and meat and vegetable preparations, their chemical composition and the assimilation of the meat. Inaug. Diss. (Russian), St. Petersburg, 1886, Table, p. 94. Nos. 166–172. Ibid., p. 96. Nos. 173–177. Ibid., p. 98. Nos. 178–181. The assimilation of the protein of millet meal. Inaug. Diss. (Russian), St. Petersburg, 1887, Table 1. Nos. 182–184. Ibid., Table 2. Nos. 185–188. Ibid., Table 3. Nos. 189–192. Ibid., Table 4. Nos. 193, 194. Ibid., Table 5. Nos. 195, 196. Ztschr. Biol., 24, pp. 23–25. Nos. 197, 198. Chemical composition and assimilation of potassium and sodium albuminates. Inaug. Diss. (Russian), St. Petersburg, 1889, Tables 1 and 2, p. 35. Nos. 199, 200. Ibid., Tables 3 and 4, p. 36. Nos. 201, 202. Ibid., Tables 5 and 6, p. 38. Nos. 203, 204. Ibid., Tables 7 and 8, p. 40. Nos. 205, 206. Ibid., Tables 9 and 10, p. 42. Nos. 207, 208. Ibid., Tables 11 and 12, p. 44. Nos. 209, 210. Ibid., Tables 13 and 14, p. 46. Nos. 211, 212. Ibid., Tables 15 and 16, p. 48. Nos. 213, 214. Ibid., Tables 17 and 18, p. 50. No. 215. Ibid., Table 19, p. 52. Nos. 216–219. Feeding man with artificial egg albuminates (Tata albumen). Inaug. Diss. (Russian), St. Petersburg, 1889, Table 1. Nos. 220, 221. Ibid., Table 2. Nos. 222–225. Ibid., Table 3. Nos. 226–228. Ibid., Table 4. Nos. 229, 230. Ibid., Table 5. No. 231. Ztschr. Biol., 26, p. 228. No. 232. Skand. Arch. Physiol., 2 (1890–91), p. 377. No. 233. Ibid., p. 379. No. 234. Ibid., p. 381. No. 235. Ibid., p. 383. No. 236. Ibid., p. 385. Nos. 237–239. Jahrb. Thier-Chem., 1892, p. 468. Nos. 240, 241. Arch. Hyg., 27, p. 182.

No. 126 was made by Lehmann in 1839. In 1837 Lehmann and Professor Hasse had lived for three weeks entirely on animal food, meat being the chief article of diet. No inconvenience was experienced and no bad after effects were noticed. This led Lehmann to try a second experiment with animal food, and eggs were selected as an article of diet because it was more convenient to determine the nitrogen in them than in meat. In order that the eggs might have the same water content they were dried for 24 hours at a temperature of 25° C. It was found that an egg then contained on an average 23.01 grams of white and 15.54 grams yolk. During 4 days 128 eggs were consumed—32 per day. This would be 736.3 grams white and 497.3 grams yolk per day. Some of the eggs were eaten raw and some boiled. The amount of albumen in the eggs was determined, and on the basis of Scherer's analyses the amount of nitrogen in the albumen calculated. The amount of carbon consumed was also calculated. The urine was collected each day, measured, and the dry matter determined. The urea was determined as follows: A sample of the urine was evaporated to about $\frac{1}{7}$ to $\frac{1}{8}$ of its volume. The urea was then taken up in 93 per cent alcohol. The alcohol was partially evaporated, the remainder diluted with water and treated with nitric acid. The nitrate of urea was filtered off and purified. The nitrogen in the urine can be calculated from the urea, and this was done in order that the experiment might be included in these tables. Lehmann did not collect the feces, therefore the amount of nitrogen in the feces when only eggs are consumed was supplied from Rubner's experiment No. 128. In Rubner's experiment the amount consumed was somewhat smaller than in Lehmann's, but this would probably make very little difference, as the nitrogen of the eggs is very completely assimilated. This experiment is interesting chiefly from an historical standpoint. It is the earliest which has been found that could be included in this summary of metabolism experiments.

Three other similar experiments were made by Lehmann with a mixed diet, a vegetable diet, and a nitrogen-free diet. No details of the food consumed are given except in the last case. The food then consisted of almond oil, starch, and sugar. The time was 3 days. The daily excretion of urea was 15.4 grams (or 7.4 grams nitrogen). The feces were not collected. According to Rieder (No. 418–420, Table 7), with similar nitrogen-free diet 0.5 to 0.9 grams nitrogen are excreted in the feces.

Nos. 127–145 were made by Rubner in the laboratory of the Physiological Institute in Munich in 1878. The object was to investigate the digestibility of a number of single food materials.

In Nos. 127 and 129 the subject was a medical student. His food consisted of lean beef, which was prepared by separating the fat, gristle, and connective tissue as completely as was practicable with shears. The meat thus prepared was fried or roasted with a little butter, onion, salt, and pepper, and eaten either with well water or carbonated water as a beverage. For purposes of analysis specimens of the meat after it had been cooked with the above materials were taken each meal time and the fat and water determined. The quantity of nitrogen in the meat was estimated. For this estimate the nitrogen content of the dry, fat-free flesh was assumed to be 14.11 per cent. Although the meat was extremely palatable, it was almost impossible for the subject to eat it on the third day. Eating meat alone caused a strong aversion to it.

The subject of No. 128 was a student of medicine. The only food was eggs, which were boiled hard in the shells and eaten with a little salt. Water was the only beverage used. The dry matter in the eggs was determined, but the nitrogen, fat, and ash were calculated from previous analyses by Voit.

In Nos. 130 and 131 the subject was a laboratory servant, 43 years old. The author wished to make the experiment with cheese alone, but could find no one willing to live upon cheese without other food; therefore milk and cheese were used together. The cheese used was Allgäuer (similar to what is called "Swiss" cheese in the United States), and the dry matter, nitrogen, fat, and ash in it were estimated from analyses of cheese made by Forster.

The subject of No. 132 was the medical student mentioned above. The food was maize meal cooked to a mush with water and butter, with the addition of grated

Parmesan cheese. The subject of the experiment did not relish the food thus prepared, and after the first meal made of it meat extract was added. Beer was used as a beverage. The composition of the food was estimated from König's compilation of analyses.

The subject of No. 133 was the same as the preceding. The food was rice, which was cooked in water or water and meat extract; a little fat and salt were added. Analyses of the food were not made, but the composition was estimated from the figures of König and others.

The subject of No. 134 was a Bavarian soldier who was accustomed to a diet consisting largely of potatoes. The food consisted of potatoes, which were boiled and eaten with salt or butter, or with oil and vinegar as salad. It is not stated whether analyses were made of the potatoes or whether the composition was estimated.

The subject of Nos. 135–140 was the laboratory servant mentioned above. In Nos. 135 and 136 the food was bread made from fine wheat flour. The dry matter, nitrogen, and ash in the flour and yeast were determined by analysis, and the results were used in computing the composition of the bread, which was made in the Physiological Institute, where the experiments were carried on.

The food in No. 137 consisted of *spätzeln*, a dish which is much eaten in the Bavarian highlands. A stiff dough is made of flour, water, and sometimes milk and eggs also. It is pressed through a sieve into boiling water and cooked for a few minutes. In this case only flour and water were used. The flour was analyzed and the composition of the *spätzeln* computed from this analysis.

The food in No. 138 consisted of black bread made from rye flour. It was analyzed.

In No. 139 the food consisted of macaroni noodles, which were cooked in salted water. It was analyzed.

In No. 140 a kind of macaroni was used which contained gluten, a substance made from wheat and containing a large amount of nitrogen. The macaroni was cooked in salted water and was analyzed. The gluten furnishes a cheap and valuable source of nitrogen.

Nos. 141 and 142 were made by Breuer in the Munich laboratory, in 1878, and reported by Rubner. Breuer himself was the subject. In No. 141 the food was Savoy cabbage, and in No. 142 carrots. The vegetables were cooked in water, with salt and a little fat.

The subject of Nos. 143 and 144 was the same laboratory servant. The food consisted of peas, which were purchased dry, carefully cleaned, and cooked in water 2 or 3 hours, and then pressed through a fine sieve. Salt was eaten with the peas, and beer was used as a beverage. Full analyses of the peas were made.

The subject of No. 145 was the medical student mentioned above. The food consisted of green beans (presumably "string beans"), which were cooked in water with some butter. It is not stated whether analyses were made of the beans, but it seems probable that they were. Rubner remarks that too much value should not be placed on this experiment, since the quantity of solid matter in the diet was too small to serve in any adequate manner as food.

The conclusions drawn from the above series of experiments have to do with the digestibility of the various foods.

Nos. 146–148 were made by Rubner in the laboratory of the Physiological Institute, at Munich, in 1882. The object was to investigate the value of wheat bran as food for man. The subject was the laboratory servant mentioned above. In No. 146 the food consisted of bread made from the finest wheat flour, in No. 147 from medium wheat flour, and in No. 148 from the entire wheat. The bread for the experiment was very carefully made from flour, yeast, water, salt, and a very little sugar. Beer and water were consumed as beverages. The dry matter, nitrogen, fat, carbohydrates, and ash in the flour, the dry matter and ash in the yeast, the dry matter, nitrogen, fat, and ash in the feces, and the nitrogen in the urine, were determined. The nitrogen in the yeast was calculated. The separation of the feces was made with charcoal or by eating meat. Meat and bread feces are each characteristic, so a separation is possible.

The conclusion is reached that the nutrients in coarse bread are not as thoroughly digested as in bread made from finer flour. The loss falls principally on the carbohydrates. The amount of material excreted in the feces increases with the increased bran content of the flour.

Nos. 149–177 were made by Solntzev in St. Petersburg in 1886. The object of the investigation was to study (1) the qualitative and quantitive composition of several kinds of canned goods, (2) the chemical composition of the ingredients of the canned goods, and (3) to compare the nutritive value of canned goods with freshly-prepared foods. The author investigated 4 kinds of canned meat (roast beef, roast mutton, ragout of beef, and ragout of mutton), and 4 kinds of canned vegetables with or without meat (sour cabbage soup, peas and meat, beans and meat, and lentils and meat). These articles were canned by order of the Russian department of war. They were compared with meats freshly prepared by cooking at a temperature of 85° C.

In the preparation of the canned goods the Appeur process, as modified by Fastier, was used. The canned goods were prepared in 1883. This investigation was made three years later, and of the 300 cans opened not a single one was spoiled as far as could be judged by taste and odor.

The subjects were prisoners in solitary confinement at the St. Petersburg military prison. They were between 22 and 26 years of age, healthy, and well built.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl method. Of the 29 tests, 6 were made with beef, 6 with mutton, 5 with beef and bread, 7 with mutton and bread, and 5 with black bread. Two other tests were made with a diet of beef and bread in which the nitrogen in the urine was not determined.

The author draws the following conclusions: The canned goods had kept as well as could be desired. The taste was tolerably satisfactory, but the meat was overcooked. The assimilation of canned meat taken alone or with black bread was considerably lower than that of freshly-cooked meat. The canned preparations were not at all homogeneous, the meat, fat, and tendon being very irregularly distributed.

Nos. 178–194 were made by Kurcheninov in St. Petersburg in 1887. The object was to investigate the assimilation of the protein of millet meal. Millet (*Panicum miliaceum*) is a cereal suited to hot and temperate climates. Millet meal is prepared by removing the hull from the grain and grinding. Five experiments are described, each consisting of four periods, (1) on a mixed diet, (2) on a diet of thin millet-meal porridge, (3) on a diet of thick millet-meal porridge, and (4) on a mixed diet.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The results obtained do not indicate that millet meal in the form of a thin or a thick porridge is well assimilated. The assimilation of the mixed diets in the first and fourth periods varied in the different experiments from 89.97 per cent to 91.08 per cent. The assimilation of the two sorts of millet-meal porridge varied from 40.04 per cent to 43.81 per cent. The author does not consider his experiments decisive, since the subjects were not used to this kind of food.

Nos. 195, 196 were made by Atwater at the Physiological Institute, in Munich, in 1882–83, to compare the nutritive values of fish and meat. The subject was a medical student. In one period fish was consumed and in the other lean beef, the amount of dry matter being about the same in each case. In addition, some fat and a little salt or other condiment was consumed also. Beer, wine, and coffee were used as beverages. The food and feces were analyzed and the specific gravity, reaction, and nitrogen in the urine were determined.

Tests were also made with a dog (see Nos. 2703, 2704, Table 28) under practically the same experimental conditions.

The conclusion was reached that fish was as well digested and absorbed as lean meat, that is (as its composition would indicate), fish has practically the same nutritive value as lean meat. The value of fish as an inexpensive article of diet is discussed.

Nos. 197–215 were made by Malakhovski in St. Petersburg in 1889. The object was to study the chemical composition and assimilation of potassium and sodium

albuminates. Four preparations of the alkaline white of eggs are found in the market, (1) sodium albuminate powder, (2) potassium albuminate powder, (3) the same alkaline albuminates in alcohol, and (4) a powder resembling egg yolk. Their composition was determined.

It is important to note that the alkalinity of these preparations is considerably greater than that of the fresh egg albumen. For instance, that of potassium albuminates is 0.269 per cent, while that of the white of an egg is 0.00523 per cent.

Nineteen experiments are described, 4 of which lasted 2 days. The remaining 15 were of 3 days' duration. The various preparations were given to the different subjects with a vegetable or mixed diet. Most of the subjects were convicts in prison. The nitrogen was determined by the Kjeldahl-Willfarth method, and the starch by the Faulenbach method.

The author sums up his conclusions as follows:

None of the subjects receiving the preparations felt well. As regards chemical composition the albuminates in alcohol resemble most nearly the normal albumen of hen's eggs. An essential and marked defect of all the preparations under consideration is the high degree of alkalinity. The assimilation of vegetable food is increased but little under the influence of the albuminates. The sodium albuminate is somewhat better assimilated than the potassium albuminate. The metabolism of nitrogen increases strikingly and especially under the influence of the potassium powder. The preparations were not satisfactorily preserved. This was especially the case with the albuminates in alcohol and with the yolk-like preparations. A putrid odor indicated decomposition. From an hygienic standpoint none of those preparations are valuable.

Nos. 216–230 were made by Kuznetsov in St. Petersburg in 1889. The object was to study the effect of feeding tata albumen. The preparations used were of two forms, a powder and a jelly. The former was either a potassium or sodium albuminate and the latter was preserved in 50 per cent alcohol.

The author himself was the subject of 12 of the tests, and the subject of 3 tests was a midwife.

The following conclusions were reached by the author: The alkaline albuminate powder was quite capable of replacing meat in supplying the organism with nitrogen, provided equal amounts of nitrogen were introduced in each case. When nearly equal quantities of vegetable and animal proteids were introduced, 63 grams of the albumen powder was sufficient not only for maintaining a nitrogen equilibrium, but also for a gain of nitrogen in the organism. A like result was obtained by using a quantity of tata jelly equal to 31.5 grams of the dry albumen. The assimilation of the tata albumen was 1 per cent less, and that of the potassium albuminate 2.5 per cent less than that of meat. The assimilation of the sodium albuminate was only 1 per cent less than that of fresh meat. It was observed that the use of the albuminates did not cause digestive or general disorders, and the weight of the body increased as compared with the meat period. The muscular energy, which was measured by a dynamometer, was found to increase on the albumen diet.

The preparations of tata albumen are tasteless, but with suitable flavoring, gravies, etc., are not at all disagreeable. Tata jelly is quite palatable.

No. 231. This experiment was made by Prausnitz in the Munich laboratory in 1889(?). The object was to study the digestibility of beans. The subject was a laboratory servant. The food consisted of white beans, which were soaked in water over night and cooked in salted water until soft. Some flour was browned in fat and this mixed with the beans, with the addition of a little vinegar and some of the water in which the beans were cooked. Analyses were made of food, urine, and feces. The chief interest in this experiment attaches to the digestion of the nitrogen. The amount undigested, 30.3 per cent, is much larger than in Rubner's experiment with peas (Nos. 113, 144); but it must be remembered that the peas were eaten in the form of a mush, while the beans were, for the most part, whole. This might have a considerable influence on the digestibility.

Nos. 232–236 were made by Hultgren and Landergren at the laboratory of the Carolinian Medical-Surgical Institute in Stockholm in 1889. The object was to compare the digestibility of margarin and butter when consumed with rye bread. The experimenters were themselves the subjects. The diet consisted of rye bread and margarin or butter. The bread was made with coarse or fine rye flour, water, and yeast, and was baked in a hard, thin cake. The composition of the margarin and of the bread, urine, and feces was determined. The separation of the feces was made with berries.

The conclusion was reached that there was a difference in the digestibility of butter and margarin. On an average 4.57 per cent of the butter fat and 6.2 per cent of the margarin fat were not digested. The conclusion was also reached that the soluble carbohydrates in the coarse bread were entirely digested.

Nos. 237–239. See Nos. 21–24, Table 1.

Nos. 240, 241 were made by Solomin at the University of Breslau in 1896. The object was to investigate the digestibility of tripe. The subject was a laboratory servant. The food consisted of bread, butter, and flour with tripe or meat. The flour was used in frying the meat or tripe. The separation of the feces was made with milk. The food, urine, and feces were analyzed.

The conclusion was reached that there was no marked difference in the digestibility of tripe and meat.

EXPERIMENTS IN WHICH ALCOHOLIC BEVERAGES, KOUMISS, AND KEPHIR WERE ADDED TO THE DIET.

In Table 4 are included 105 tests with man, in 66 of which beer, wine, or other similar alcoholic beverages were added to the diet in varying amounts. In 39 tests koumiss or kephir was consumed, with or without other food. One of the principal objects sought in the experiments of the first group was to determine whether or not alcohol is a nutrient; in other words, whether by being consumed in the organism it serves as a protector of protein in the same way as fat or carbohydrates. The effect of alcohol upon the digestibility of fats and carbohydrates was also studied.

Although the interest in problems of the sort mentioned is very widespread, the number of experiments is comparatively limited. Very many experiments of a different nature on the effects of alcohol have been made. A bibliography of the literature on the subject, with brief notes as to the character of the works cited, has been prepared by Dr. John S. Billings.[1]

In the experiments of the second group alcoholic beverages were studied which are unquestionably foods as well. Koumiss and kephir are made by fermenting mares' or cows' milk. In koumiss the fermentation is produced bylactic acid and the characteristic ferments of alcohol and in kephir it is produced by a special organism, *Saccharomyces kephiri*. The process of manufacture is described by Munk and Uffelmann.[2] These beverages contain considerable protein, a portion of which is said to be partially digested by the process of manufacture.

[1] Bibliography (preliminary) of the Literature on the Physiological and Pathological Effects of Alcohol and Alcoholic Drinks. Washington, 1894.

[2] Munk and Uffelmann, Ernährung des Gesunden und Kranken Menschen, pp. 413–416.

TABLE 4.—*Experiments in which alcoholic beverages, koumiss, and kephir were added to the diet.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
242	1860–61	Parkes and Wollowicz.	Man (F. B.)	18	......	Bread, beef, fat, butter, etc., water	4	17.3	16.0	1.6	— 0.3	
243	1860–61	do	do	18	......	Bread, beef, fat, butter, etc., alcohol	4	17.3	16.8	2.0	— 1.5	
244	1870–71	do	Man	28	......	Bread, beefsteak, fat, butter, sugar, milk, potatoes, salt, water.	10	17.3	16.5	2.9	— 2.1	
245	1871–72	do	do	28	......	Same as No. 244, with 284 to 568 cc. claret	10	17.3	16.4	1.3	— 0.4	
246	1871–72	Parkes	Soldier	30	......	Oatmeal, milk, salt, water	6	20.0	15.2	3.8	+ 1.0	No work.
247	1871–72	do	do	30	......	do	3	20.0	16.3	5.0	— 1.3	Work.
248	1871–72	do	do	30	......	do	3	20.0	15.9	3.3	+ 0.8	No work.
249	1871–72	do	do	30	......	Oatmeal, milk, salt, brandy (=159.7 gm. alcohol).	3	20.0	15.8	4.4	— 0.2	Work.
250	1871–72	do	do	30	......	Oatmeal, milk, salt	1	20.0	15.0	3.2	+ 1.7	No work.
251	1889	Mogilianski	Laborer (R.)	25	59	307 gm. meat, 839 gm. bread, 2,156 gm. water, 60 gm. alcohol.	5	28.2	22.2	2.2	+ 3.8	
252	1889	do	do	25	59	306 gm. meat, 830 gm. bread, 2,420 gm. water.	5	29.0	25.5	2.2	+ 1.3	
253	1889	do	Student (E.) military school.	18	55	403 gm. meat, 403 gm. bread, 860 gm. milk, 5,740 gm. water, 60 gm. alcohol.	5	30.7	24.7	2.2	+ 3.8	
254	1889	do	do	18	55	334 gm. meat, 543 gm. bread, 1,030 gm. milk, 2,112 gm. water.	5	30.3	22.1	1.7	+ 6.5	
255	1889	do	Laborer (T.)	18	63	507 gm. meat, 880 gm. bread, 2,156 gm. water, 80 gm. alcohol.	5	29.7	23.4	1.6	+ 4.7	
256	1889	do	do	18	64	310 gm. meat, 850 gm. bread, 2,420 gm. water.	5	29.5	26.1	2.2	+ 1.2	
257	1889	do	Student (P.)	23	68	402 gm. meat, 389 gm. bread, 860 gm. milk, 2,156 gm. water, 80 gm. alcohol.	5	31.3	20.6	1.5	+ 9.2	
258	1889	do	do	23	68	349 gm. meat, 364 gm. bread, 544 gm. milk, 3,100 gm. water.	5	25.2	20.5	2.1	+ 2.6	
259	1889	do	Student (M.)	26	64	300 gm. meat, 465 gm. bread, 1,000 gm. milk, 840 gm. water, 300 gm. jelly, 80 gm. alcohol, 30 gm. butter.	5	21.4	20.0	1.8	— 0.4	
260	1889	do	do	26	64	300 gm. meat, 469 gm. bread, 1,000 gm. milk, 800 gm. water, 30 gm. butter, 300 gm. jelly.	5	23.1	18.3	2.6	+ 2.2	
261	1889	do	Student (P. H.)	20	62	400 gm. meat, 485 gm. bread, 180 gm. milk, 1,680 gm. water, 300 gm. bouillon.	6	28.2	21.8	1.0	+ 5.4	
262	1889	do	do	20	62	399 gm. meat, 525 gm. bread, 285 gm. milk, 1,170 gm. water, 397 gm. bouillon, 100 gm. alcohol.	6	30.6	19.0	0.9	+10.7	
263	1889	do	Student (V.)	23	59	315 gm. meat, 716 gm. bread, 450 gm. milk, 1,320 gm. water.	6	26.7	23.9	2.0	+ 0.8	

TABLE 4.—*Experiments in which alcoholic beverages, koumiss, and kephir were added to the diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
264	1889	Mogilianski	Student (V.)	23	60	326 gm. meat, 674 gm. bread, 318 gm. milk, 1,365 gm. water, 100 gm. alcohol.	6	27.6	25.1	1.7	+0.8	
265	1889	.....do	Student (S.)	22	69	300 gm. meat, 459 gm. bread, 1,080 gm. milk, 600 gm. water, 75 gm. butter, 100 gm. jelly.	5	22.0	21.7	1.7	—1.4	
266	1889	.....do	.....do	22	69	300 gm. meat, 449 gm. bread, 1,040 gm. milk, 520 gm. water, 75 gm. butter, 100 gm. jelly, 100 gm. alcohol.	5	22.8	22.4	1.3	—0.9	
267	1889	.....do	Student (B.)	24	65	300 gm. meat, 437 gm. bread, 828 gm. milk, 1,144 gm. water, 50 butter, 200 gm. jelly.	5	20.6	16.7	1.1	+2.8	
268	1889	.....do	.....do	24	65	300 gm. meat, 298 gm. bread, 840 gm. milk, 1,128 gm. water, 50 gm. butter, 148 gm. jelly, 100 gm. alcohol.	5	18.2	13.2	0.8	+4.2	
269	1889	.....do	Soldier (K.)	24	66	297 gm. meat, 807 gm. bread, 1,393 gm. water, 120 gm. alcohol.	7	31.2	24.5	2.0	+4.7	
270	1889	.....do	.....do	24	66	297 gm. meat, 742 gm. bread, 1,250 gm. water..	7	30.0	24.2	2.1	+3.7	
271	1889	.....do	Student (M.)	29	62	300 gm. meat, 721 gm. bread, 960 gm. milk, 1,000 gm. water, 75 gm. butter, 280 gm. jelly.	5	24.7	20.6	1.7	+2.4	
272	1889	.....do	.....do	29	62	300 gm. meat, 619 gm. bread, 960 gm. milk, 920 gm. water, 75 gm. butter, 300 gm. jelly, 140 gm. alcohol.	5	24.7	18.1	1.9	+4.7	
273	1889	.....do	Man (B.)	28	67	256 gm. meat, 310 gm. bread, 500 gm. milk, 1,429 gm. water, 140 gm. alcohol.	5	21.6	20.4	1.9	—0.7	
274	1889	.....do	.....do	28	67	270 gm. meat, 443 gm. bread, 500 gm. milk, 1,890 gm. water.	5	25.3	26.8	3.3	—4.8	
275	1889	.....do	Clerk (V.)	24	77	272 gm. meat, 706 gm. bread, 500 gm. milk, 1,650 gm. water, 140 gm. alcohol.	5	29.3	23.4	2.5	+3.4	
276	1889	.....do	.....do	24	77	270 gm. meat, 676 gm. bread, 500 gm. milk, 2,100 gm. water.	5	29.3	26.2	3.3	—0.2	
277	1889	.....do	Student (K.)	23	80	406 gm. meat, 492 gm. bread, 1,071 gm. milk, 2,536 gm. water, 140 gm. alcohol.	7	33.8	21.7	2.2	+9.9	
278	1889	.....do	.....do	23	80	400 gm. meat, 615 gm. bread, 1,014 gm. milk, 3,214 gm. water.	7	32.6	22.7	2.7	+7.2	
279	1889	.....do	Student (M.)	24	67	400 gm. meat, 216 gm. bread, 920 gm. milk, 1,700 gm. water, 140 gm. alcohol.	5	30.0	19.1	1.2	+9.7	
280	1889	.....do	.....do	24	67	400 gm. meat, 323 gm. bread, 930 gm. milk, 2,000 gm. water.	5	27.9	19.7	1.9	+6.3	

281	1891	Zuntz and Magnus-Levy.	Observer (Z.)	....	....	572.1 gm. bread, 20 gm. sugar, 1,611 cc. beer, 515 cc. tea, 113 gm. butter.	3	9.0	9.6	2.0	—2.6	
282	1891	.....do	Observer (M.-L.)	....	....	684 gm. bread, 132.8 gm. butter, 20 gm. sugar, 1,626 cc. beer, 578 cc. tea.	5	11.1	12.8	1.5	—3.2	
283	1891	.....do	Observer (Z.)	....	....	740.2 gm. bread, 147.8 gm. butter, 51 gm. sugar, 719 cc. tea.	4	11.0	9.5	1.7	—0.2	
284	1891	.....do	Observer (M.-L.)	....	....	692.5 gm. bread, 140 gm. butter, 20 gm. sugar, 1,800 cc. beer, 600 cc. tea, 450 cc. water.	4	11.2	11.2	2.3	—2.3	
285	1891	Stammreich	Observer	23½	52.5	200 gm. meat, 200 gm. white bread, 200 gm. potatoes, 200 gm. apples, 115 gm. butter, 40 gm. sugar, 300 cc. beer (=12 cc. alcohol).	3	11.3	9.9	1.4	0.0	
286	1891	.....do	.....do	23½	52.5	200 gm. meat, 200 gm. white bread, 200 gm. potatoes, 200 gm. apples, 40 gm. sugar, 82.4 gm. alcohol (on 1 day, 75.4 gm.).	4	11.3	11.4	1.0	—1.1	
287	1891	.....do	.....do	23½	52.5	Same as No. 285	6	11.3	10.1	1.2	0.0	
288	1891	.....do	Woman	....	49	1,500 gm. milk, 210 gm. bread, 60 gm. butter, 80 gm. meat, 80 gm. egg.	7	15.3	13.2	1.5	+0.6	
289	1891	.....do	.....do	....	49	1,500 gm. milk, 210 gm. bread, 80 gm. meat, 80 gm. egg, 200 gm. cognac (=65 gm. alcohol).	3	15.3	13.5	1.7	+0.1	
290	1891	.....do	.....do	....	49	Same as No. 285	4	15.4	13.4	1.4	+0.6	
291	1892	Miura	Observer	27	46.5	60 gm. sausage, 420 gm. rice, 5 gm. meat extract, 192 gm. salted cucumber, 4 gm. salt, 2,200 gm. water.	5	7.3	8.2	1.0	—1.9	
292	1892	.....do	.....do	27	....	.....do	1	7.3	6.9	1.0	—0.6	Last day of No. 291.
293	1892	.....do	.....do	27	....	60 gm. sausage, 278 gm. rice, 5 gm. meat extract, 192 gm. salted cucumber, 160.5 gm. arack (=65 gm. alcohol), 48.5 gm. meat, 4 gm. salt, 2,200 gm. water.	4	7.3	8.7	1.1	—2.5	The arack and meat were equivalent to 142 gm. rice.
294	1892	.....do	.....do	27	....	Same as No. 291	4	7.3	7.8	0.4	—0.9	
295	1892	.....do	.....do	27	....	.....do	1	7.3	6.8	0.4	+0.1	Last day of No. 294.
296	1892	.....do	.....do	27	....	60 gm. sausage, 278 gm. rice, 5 gm. meat extract, 192 gm. salted cucumber, 47.1 gm. meat, 4 gm. salt, 2,200 gm. water.	3	7.3	8.9	0.4	—2.0	The meat was substituted for 142 gm. rice.
297	1892	.....do	.....do	27	....	370 gm. rice, 320 gm. meat, 40 gm. butter, 5 gm. meat extract, 200 gm. salted cucumber, 10 gm. salt, 2,440 gm. water.	6	15.8	14.2	0.7	+0.9	
298	1892	.....do	.....do	27	....	.....do	1	15.8	14.0	0.7	+1.1	Last day of No. 297.
299	1892	.....do	.....do	27	....	228 gm. rice, 366 gm. meat, 40 gm. butter, 5 gm. meat extract, 200 gm. salted cucumber, 65.9 gm. alcohol, 10 gm. salt, 2,440 gm. water.	4	15.8	16.7	0.7	—1.6	The alcohol and 46 gm. meat were equivalent to 142 gm. rice.
300	1892	.....do	.....do	27	....	.....do	1	15.8	17.8	0.7	—2.7	Last day of No. 299.
301	1892	.....do	.....do	27	....	.....do	4	15.8	14.5	0.8	+0.5	
302	1892	.....do	.....do	27	....	.....do	1	15.8	14.0	0.8	+1.0	Last day of No. 301.
303	1892	.....do	.....do	27	....	228 gm. rice, 365 gm. meat, 40 gm. butter, 5 gm. meat extract, 200 gm. salted cucumber, 4 gm. salt, 2,440 gm. water.	3	15.8	16.4	0.8	—1.4	45 gm. meat was substituted for 142 gm. rice.
304	1892	.....do	.....do	27	....	.....do	1	15.8	17.9	0.8	—2.9	Last day of No. 303.
305	1892	.....do	.....do	27	....	370 gm. rice, 320 gm. meat, 40 gm. butter, 5 gm. meat extract, 200 gm. salted cucumber, 10 gm. salt, 2,440 gm. water.	3	15.9	13.9	1.1	+0.9	

TABLE 4.—*Experiments in which alcoholic beverages, koumiss, and kephir were added to the diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
306	1892	Miura	Observer	27		228 gm. rice, 366 gm. meat, 40 gm. butter, 5 gm. meat extract, 200 gm. salted cucumber, 65.9 gm. alcohol, 4 gm. salt, 2,440 gm. water.	2	15.9	16.4	0.8	— 1.3	Alcohol and 46 gm. meat equivalent to 142 gm. rice.
307	1892	...do	...do	27		...do	1	15.9	17.7	0.8	— 2.6	Last day of No. 306.
308	1885	Korkounov	Man (J. M.)		59.8	Wheat bread, milk, tea	2	17.9	21.3	1.9	— 5.3	
309	1885	...do	...do		59.8	Wheat bread, milk, tea, 1,590 cc. koumiss (made from mare's milk).	3	22.6	26.4	2.1	— 5.9	Chronic catarrh of the intestines.
310	1885	...do	Man (I. S.)			Wheat bread, milk, tea	2	19.8	17.2	1.9	+ 0.7	Do.
311	1885	...do	...do			Wheat bread, milk, tea, 1,267 cc. koumiss	3	21.0	18.7	2.0	+ 0.3	
312	1885	...do	Man (J. K.)		63.1	Wheat bread, milk, tea	2	19.6	14.2	2.6	+ 2.8	
313	1885	...do	...do		63.1	Wheat bread, milk, tea, 1,567 cc. koumiss	3	23.6	19.3	1.9	+ 2.2	
314	1888	Alexeyev	Soldier		62.3	1,093 gm. bread, 1,251 gm. soup, 100 gm. meat, 30 gm. blackberries (1 day).	4	23.9	15.9	4.1	+ 3.9	
315	1888	...do	...do		63.3	1,204 gm. bread, 30 gm. blackberries (1 day), 2,171 gm. kephir.	3	31.2	15.9	3.0	+12.3	
316	1888	...do	...do		63.4	1,053 gm. bread, 1,258 gm. soup, 115 gm. meat, 30 gm. blackberries (1 day).	3	25.8	17.9	3.0	+ 4.9	
317	1888	...do	Student (S.)		57.3	354 gm. white bread, 268 gm. black bread, 855 gm. soup, 178 gm. boiled meat, 177 gm. roast meat, 30 gm. blackberries (1 day).	3	30.2	18.4	3.5	+ 8.3	
318	1888	...do	...do		59.2	1,330 gm. white bread, 30 gm. blackberries (1 day), 6,535 gm. kephir.	6	23.7	18.7	1.8	+ 3.2	
319	1888	...do	...do		59.4	778 gm. white bread, 737 gm. bouillon, 120 gm. meat, 186 gm. roast meat, 30 gm. blackberries (1 day).	3	27.5	19.3	2.7	+ 5.5	
320	1888	...do	Student (A.)		59.4	811 gm. white bread, 1,054 gm. bouillon, 275 gm. meat, 20 gm. blackberries (1 day).	3	26.4	19.7	2.7	+ 4.0	
321	1888	...do	...do		59.5	771 gm. white bread, 561 gm. bouillon, 143 gm. meat, 20 gm. blackberries (1 day), 1,292 gm. kephir.	8	27.8	22.1	2.4	+ 3.3	
322	1888	...do	...do		59.5	20 gm. blackberries (1 day), 3,407 gm. kephir.	2	18.8	17.7	1.7	— 0.6	
323	1888	...do	...do		59.9	789 gm. white bread, 712 gm. bouillon, 213 gm. meat, 20 gm. blackberries (1 day).	3	23.9	21.1	2.4	+ 0.4	

324	1888	.....do	Assistant surgeon (K.)	....	45.9	714 gm. white bread, 937 gm. bouillon, 248 gm. meat, 20 gm. blackberries (1 day).	3	24.1	17.1	2.4	+ 4.6
325	1888	.....do	.....do	....	46.8	20 gm. blackberries (1 day), 1,308 gm. kephir.	7	28.5	21.1	2.3	+ 5.1
326	1888	.....do	.....do	....	46.7	20 gm. blackberries (1 day), 2,627 gm. kephir.	3	14.3	13.7	1.0	— 0.4
327	1888	.....do	.....do	....	46.3	750 gm. white bread, 664 gm. bouillon, 221 gm. meat, 20 gm. blackberries (1 day).	3	23.8	16.2	2.2	+ 5.4
328	1888	.....do	Student (Y.)	....	49.3	894 gm. white bread, 868 gm. bouillon, 180 gm. meat.	3	21.0	13.7	2.3	+ 5.0
329	1888	.....do	.....do	....	50.1	705 gm. white bread, 518 gm. bouillon, 147 gm. meat, 30 gm. blackberries (2 days), 1,441 gm. kephir.	7	27.2	19.2	1.7	+ 6.3
330	1888	.....do	.....do	....	50	30 gm. blackberries (1 day), 3,289 gm. kephir	2	18.6	15.1	1.2	+ 2.3
331	1888	.....do	.....do	....	49.6	580 gm. white bread, 761 gm. bouillon, 215 gm. meat.	3	21.3	17.7	2.2	+ 1.4
332	1888	.....do	Student (P.)	....	69.1	578 gm. white bread, 897 gm. bouillon, 262 gm. meat.	3	20.8	18.3	2.3	+ 0.2
333	1888	.....do	.....do	....	69.6	658 gm. white bread, 471 gm. bouillon, 152.4 gm. meat, 30 gm. blackberries (2 days), 1,440 gm. kephir.	7	26.4	20.6	2.1	+ 3.7
334	1888	.....do	.....do	....	70	614 gm. white bread, 30 gm. blackberries (1 day), 3,127 gm. kephir.	2	27.9	23.3	2.1	+ 2.5
335	1888	.....do	.....do	....	69.4	396 gm. white bread, 749 gm. bouillon, 226 gm. meat, 30 gm. blackberries (1 day).	3	18.7	15.9	2.1	+ 0.7
336	1888	.....do	Student (M.).	....	65.1	346 gm. white bread, 174 gm. black bread, 708 gm. soup, 153 gm. meat, 30 gm. blackberries (1 day).	3	28.4	11.1	4.8	+ 2.5
337	1888	.....do	.....do	....	64.5	671 gm. white bread, 30 gm. blackberries (1 day), 1,924 gm. kephir.	6	22.4	12.1	4.5	+ 5.8
338	1888	.....do	.....do	....	65.4	532 gm. white bread, 605 gm. bouillon, 114 gm. boiled meat, 185 gm. roast meat, 30 gm. blackberries (1 day).	3	23.2	15.5	3.0	+ 4.7

Nos. 242, 243. Proc. Roy. Soc., London, 13, p. 382. Nos. 244, 245. Ibid., 19, p. 84. Nos. 246–250. Ibid., 20, p. 405. Nos. 251, 252. Influence of alcohol on the assimilation and metabolism of nitrogen and the assimilation of fat. Inaug. Diss. (Russian), St. Petersburg, 1889, p. 39. Nos. 253, 254. Ibid., p. 40. Nos. 255, 256. Ibid., p. 41. Nos. 257, 258. Ibid., p. 42. Nos. 259, 260. Ibid., p. 43. Nos. 261, 262. Ibid., p. 44. Nos. 263, 264. Ibid., p. 45. Nos. 265, 266. Ibid., p. 46. Nos. 267, 268. Ibid., p. 47. Nos. 269, 270. Ibid., p. 48. Nos. 271, 272. Ibid., p. 49. Nos. 273, 274. Ibid., p. 50. Nos. 275, 276. Ibid., p. 51. Nos. 277, 278. Ibid., p. 52. Nos. 279, 280. Ibid., p. 53. No. 281. Arch. Physiol., 49, p. 444. No. 282. Ibid., p. 447. No. 283. Ibid., p. 449. No. 284. Ibid., p. 451. Nos. 285–287. Ueber den Einfluss des Alkohols auf den Stoffwechsel des Menschen. Inaug. Diss., Berlin, 1891, p. 33. Nos. 288–290. Ibid., p. 37. Nos. 291–296. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. I, p. 4. Nos. 297–307. Ibid., p. 8. Nos. 308–313. Vrach, 6, p. 729. Nos. 314–316. The assimilation of nitrogen when kephir is consumed. Inaug. Diss. (Russian), St. Petersburg, 1888, p. 2. Nos. 317–319. Ibid., p. 4. Nos. 320–323. Ibid., p. 6. Nos. 324–327. Ibid., p. 8. Nos. 328–331. Ibid., p. 10. Nos. 332–335. Ibid., p. 12. Nos. 336–338. Ibid., p. 14.

Nos. 242, 243 were made by Parkes and Wollowicz in 1860. The object was to study the effect of alcohol on the human body. Five experiments were made. In three experiments water was the beverage consumed, in one 28.4 to 227.2 cubic centimeters of absolute alcohol was consumed, and in another 341 cubic centimeters of brandy. The food consisted of a mixed diet. In every case the nitrogen of the food and the nitrogen and urea of the urine were determined. The nitrogen of the feces was determined on one day of one water period, and on one day of the period in which absolute alcohol was consumed. Therefore these are the only tests included in the table. In every case the amount of nitrogen in the food consumed was 17.3 grams. In the two periods not included in the table, when water was consumed, 17 grams and 16 grams of nitrogen, respectively, were excreted in the urine, and in the period in which brandy was consumed, 16.4 grams. The conclusion was reached that alcohol and brandy had no effect on the excretion of nitrogen.

Nos. 244, 245 were made by Parkes and Wollowicz in 1870. The object was to study the effect of claret on the human body. The subject was a healthy man. The food was a simple mixed diet, consisting of bread, beefsteak (fat used for frying the steak), butter, sugar, milk, potatoes, and salt.

For 16 days before the experiment began the subject drank only water. In the first test (No. 244) water was used as a beverage, and in the second (No. 245) a good claret (Haut Brion, 1863), containing 10 per cent alcohol. The nitrogen in the food was calculated on the basis of former analyses. The food was found by previous experiments to be very uniform in composition. The bread was made at the hospital bakery at Netley. The nitrogen and urea in the urine were determined, and on the last day of each experiment the nitrogen in the feces.

The claret had no effect on the nitrogen excretion. The action of the heart was increased, the increase being proportional to the quantity of alcohol consumed. No other effects of importance were noticed. The author believes that alcohol was not necessary or desirable for the subject of these experiments.

A third test was made with the same diet and water as a beverage. The nitrogen in the urine was 17.5 grams. The nitrogen in the feces was not determined, and the results are not included in the table.

Nos. 246–250 were made by Parkes in 1872, and form a series with Nos. 242–245 and 858–867, Table 10. The object was to study the effect of alcohol and exercise on the human body. The subject was a powerfully built Scotchman. He was very temperate, drinking only a little beer and occasionally spirits.

The food in these experiments was oatmeal and milk. The nitrogen in the food, urine, and feces was determined.

In No. 249 the subject consumed daily 355 cubic centimeters of brandy.

When no work was done the subject took exercise by walking slowly. The work consisted of digging ground for eight or nine hours per day. He was fatigued by this labor.

The principal conclusions were as follows: Brandy did not affect the excretion of nitrogen during exercise (work) or when no work was done.

The brandy increased the action of the heart to such an extent that it lessened the amount of work the subject was able to perform.

Nos. 251–280 were made by Mogilianski in St. Petersburg in 1889. The object was to study the influence of alcohol on the assimilation and metabolism of nitrogen and the assimilation of fats.

Experiments with 15 subjects were carried out by the author. All the subjects were young and healthy, the majority being students of the Military Medical Academy. The food consisted of meat freed as much as possible from fat, milk, bread, butter, tea, water, and in some cases beef tea and jelly. The determination of nitrogen in all the food materials, as well as in the urine and feces, was made by the Kjeldahl-Borodin method. The tea and jelly contained very small quantities of nitrogen. Each experiment covered 10 to 14 days, and was divided into periods, one with and one without alcohol. Food was taken three times a day, and each meal was accompanied by a dose of alcohol during one period. The amount of

alcohol (absolute) given to the subjects daily varied from 60 to 140 cubic centimeters. It was diluted with distilled water to 40° to 42° Tralles. Some of the subjects were long accustomed to alcohol and consumed much of it, others drank it only occasionally, and still others abstained altogether from alcoholic beverages. The portion of alcohol administered to each subject was determined by his habits, the rule being to give a sufficient quantity to cause slight intoxication.

The author draws the following conclusions: Temporary drinking of alcohol in moderate doses, by those accustomed to it, increases the appetite and causes an improvement in the assimilation of the nitrogenous constituents of the food. The assimilation decreases in persons not used to alcohol. The quantity of the fatty acids excreted in the feces is larger when small doses of alcohol are taken than when none is consumed. The reverse is true when larger but still moderate doses are taken. In other words, the assimilation of fats decreases under the influence of alcohol. The decomposition of protein in the body decreases strikingly under the influence of alcohol. Moderate doses always cause this, and small doses frequently do so. In these experiments it was observed that a quantitative lowering of the metabolism did not depend on the alcohol taken. Persons not accustomed to alcohol are more affected by it than those accustomed to it. Alcohol does not increase the amount of urine.

Nos. 281–284 were made by Zuntz and Magnus-Levy at the Agricultural Institute in Berlin in 1890. The object was to study the digestibility and nutritive value of bread, and also the effect of alcohol on metabolism. The subjects were the investigators themselves. One of them was an habitual beer drinker, consuming 1,000 to 1,500 cubic centimeters per day. The other used very little beer, about 300 cubic centimeters per day.

The food consisted of bread, butter, tea with sugar, and beer. The bread was made by the investigators themselves from weighed quantities of materials which were analyzed. That used in Nos. 281 and 283 consisted of wheat flour, yeast, water, and salt. It was glazed with beaten egg. That used in Nos. 284 and 285 consisted of wheat flour to which 20 per cent of potato starch had been added, and skimmed milk, yeast, and salt. It is described as being light and having a fine taste. It had been suggested some years before by one of the investigators that when starch was cheaper than flour it could be economically used in bread. This would decrease the amount of nitrogen. Therefore skimmed milk was used to make good this deficiency.

The food, urine, and feces were analyzed. The following conclusions were reached: The diet, though containing very little protein, was well assimilated. No diminution in its nutritive value was noticed when bread was used which contained potato starch. Alcohol exercised no bad effect on digestibility, even when 60 grams per day was consumed.

In connection with the above work respiration experiments, in which the respiratory quotient was determined, were made. They are, however, not published in detail. Accuracy within 2 or 3 per cent was claimed in the estimation of carbon dioxid. On the basis of these experiments considerable space is devoted to a consideration of the use which is actually made of the oxygen consumed from the air. It is believed that when a man performs no severe mechanical labor more than half of the oxygen consumed in a day is used in the production of internal muscular work. Further, with a diet of bread and butter the work of digestion itself requires a consumption of oxygen equal to 10 per cent of that required when no work is performed, or, in other words, 5 per cent of the food consumed by a person at moderate labor is expended in furnishing energy for the labor of digestion.

Nos. 285–290 were made by Stammreich in the medical department of the University of Berlin in 1890–91 (?) under the direction of von Noorden. The object was to study the influence of alcohol on metabolism. The subject of Nos. 285–287 was the investigator himself, and the subject of Nos. 288–290 was a woman.

In No. 285 the diet consisted of meat, bread, potatoes, beer, etc. The fuel value of the diet was 2,241 calories. In No. 286 alcohol was substituted for fat The fuel value was practically the same. In No. 287 the food and fuel value were as in No. 285. In No. 288 the food consisted of milk, bread, butter, meat, and eggs. The fuel

value was, on an average, 2,200 calories per day. In No. 289 the butter was omitted and 65 grams of alcohol, its isodynamic equivalent, was substituted (fat : alcohol : : 7 : 9.3). The alcohol was in the form of cognac. In No. 290 the diet was as at first.

The metabolism of nitrogen was practically the same under the three conditions in both series of experiments.

The conclusion is reached that alcohol is a food and can take the place of fat as a protector of protein.

A very complete review of the previous work in this connection is included in the account of these experiments.

Nos. 291–307 were made by Miura in Berlin in 1891 to investigate the influence of alcohol on metabolism. The investigator himself was the subject. He was a Japanese, strong, but rather small in stature.

In Nos. 291–296 the diet contained a small amount of protein. It consisted of rice and sausage, with some meat extract and salted cucumber (*Salzgurke*). In Nos. 297–307 the diet was much richer in protein. It consisted of rice, meat, and butter, with meat extract and salted cucumber. In Nos. 293, 296, 299, 303, and 306 a smaller amount of rice was consumed. In Nos. 293, 299, and 306 alcohol in the form of arack or brandy was substituted for the carbohydrates of the rice, and some meat was added to make up for the protein. The quantities of alcohol and meat were calculated to be equivalent to the amount of rice omitted. In Nos. 296 and 303 an equivalent amount of meat was consumed in place of the protein of the rice, but nothing was substituted for the carbohydrates.

The feces were separated with charcoal taken in a solution of gum arabic. Analyses of the food, urine, and feces were made.

The author draws attention to the fact that the belief is quite general that alcohol in small quantities can be substituted for carbohydrates, though proof on this point is not abundant. In these experiments every precaution was taken to insure accuracy, and the conclusion was reached that alcohol did not take the place of carbohydrates as a protector of protein. It will be seen by reference to the table that just as much nitrogen was lost per day by the organism when alcohol was substituted for part of the carbohydrates as was the case when both alcohol and carbohydrates were omitted.

Nos. 308–313 were made by Korkounov at the University at St. Petersburg in 1885. The object was to study the metabolism and assimilation of nitrogen when koumiss was consumed. Three experiments are described. The subject of Nos. 310,311 had been treated with koumiss for 3 years for chronic intestinal catarrh. The other subjects were healthy persons. The experiments were divided into two periods. In the first period the diet consisted of wheat bread, milk, and tea, and in the second koumiss made from mare's milk was consumed in addition in gradually increasing amounts. The koumiss used in the experiments was from 8 to 26 days old. The nitrogen in food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: When koumiss was consumed, the metabolism of nitrogen was increased, and the assimilation of nitrogen was increased in two cases and very slightly decreased in one.

In connection with this work an experiment may be mentioned which was undertaken by Kosturine at the University of St. Petersburg in 1885 to investigate the assimilation of koumiss. The subject was a healthy man, 21 years old. The experiment lasted 3 days. On the first day the subject consumed koumiss alone, and on the second and third days koumiss with baked potatoes and English cakes. During the whole period 10,500 cubic centimeters of koumiss was consumed. The nitrogen in the food and feces was determined by the soda-lime method. The total income of nitrogen was 25.5 grams, the total outgo in the feces 1.1 grams.

The conclusion was reached that 95.6 per cent of the nitrogen of koumiss was assimilated.

In the 3 days 8,186 cubic centimeters of urine of 1.010 specific gravity was excreted. The nitrogen of the urine was not determined.

Nos. 314–338 were made by Alexeyev in St. Petersburg in 1887–88. The object was to study the metabolism and the assimilation of nitrogen on a diet containing kephir. Kephir is a fermented beverage made from cow's milk. It is prepared with

a special ferment called kephir yeast. According to the length of time which the milk is fermented the kephir is distinguished as weak (fermented 1 day), medium (fermented 2 days), or strong (fermented 3 days). The total protein in kephir and milk is about the same, but the constituents of the protein vary considerably, as is shown by the following table:

Composition of protein of milk and kephir.

	Casein.	Albumen.	Acid albumen.	Hemialbumose.	Peptones.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Milk	87.30	8.20	....	4.50	....
Kephir	81.68	3.02	6.73	7.84	0.83

In addition to protein, kephir contains mineral salts, alcohol, carbonic acid, and lactic acid.

Seven experiments are described. All the subjects were healthy men, students or physicians. The majority of the experiments were divided into four periods. They began and ended with a period on a mixed diet consisting of bread, soup, and meat. During the second period kephir in gradually increasing amounts, beginning with 1½ glasses per day, was added to the diet. In the third period kephir alone or with bread was consumed. In a number of cases the experiments consisted of but three periods, the first and third on a mixed diet, and the second on a diet of bread and kephir.

The feces were separated by means of blackberries. The amount, specific gravity, reaction, and nitrogen content of the urine were determined. It was also examined for albumen and sugar. The food and feces were analyzed daily. In every case the nitrogen was determined by the Kjeldahl-Borodin method.

The author drew the following conclusions: The weight of the body increased when kephir was added to the mixed diet. When kephir alone was consumed the weight of the body decreased, since it did not furnish sufficient protein for the needs of the organism. In nearly every case the quantity of urine increased when kephir was consumed alone or with other foods and the specific gravity decreased, being least on an absolute kephir diet. When kephir was consumed with other food the amount of nitrogen in the urine increased. This was thought to be due to the increased supply of nitrogenous material in the food and to intensified metabolism. On an absolute kephir diet the amount of nitrogen excreted in the urine decreased. When kephir was consumed alone or with other foods the amount of feces decreased. In the majority of cases more nitrogen was retained in the body when kephir was added to the diet. On an absolute kephir diet the income of nitrogen exceeded the outgo in one case only (No. 330). In nearly every case the metabolism and assimilation of nitrogen increased when kephir was consumed.

In general, the author concludes that the effect of kephir on the organism is similar in many respects to that of milk and kumiss.

The author gives a review of the literature of kephir, including methods of preparation, chemical composition, microscopical and bacteriological investigations, physiological action, and therapeutical application.

EXPERIMENTS IN WHICH PEPTONES AND SIMILAR PREPARATIONS WERE ADDED TO THE DIET.

In Table 5 are included 2 tests with men and 8 with women in which peptones or similar preparations were added to the diet. Peptones differ from ordinary meat extracts in that the latter contain principally nitrogen of extractives, while the former contain considerable quantities of proteoses, albumoses, and similar compounds. They are therefore foods and not simply stimulants. Peptones are prepared by partially digesting meat, milk, or other food materials, and find their chief application in the feeding of invalids. Experiments in which they were used for this purpose will be found in Nos. 2222, 2223, Table 24.

TABLE 5.—*Experiments in which peptones and similar preparations were added to the diet.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
339	1889	Munk	Man	31	61.1	1,000 cc. milk, 282 gm. bread, 60 gm. butter, 600 cc. broth, 60 gm. peptone (102 gm. protein, 84 gm. fat, 194 gm. carbohydrates, 2,016 calories).	3	15.9	16.0	1.4	—1.5	
340	1889	....do	....do	31	61.1	1,100 cc. broth, 1,000 cc. milk, 382 gm. bread, 60 gm. butter (102 gm. protein, 84 gm. fat, 194 gm. carbohydrates, 2,016 calories).	2	15.9	15.5	1.3	—0.9	500 cc. broth was substituted for peptone.
341	1892	Deiters	Woman	29	......	175 gm. meat, 30 gm. meat extract, 250 gm. rice, 25 gm. cocoa, 300 gm. bouillon with egg, 300 cc. soup, 40–50 gm. butter, 100 gm. sugar, 15–25 gm. salt, 1 bottle selters water, 120 cc. wine.	4	12.8	11.7	1.6	—0.5	
342	1892	....do	....do	29	......	300 cc. peptone, 250 gm. rice, 25 gm. cocoa, 300 gm. bouillon with egg, 300 cc. soup, 40–50 gm. butter, 100 gm. sugar, 15–25 gm. salt, 120 cc. wine, 1 bottle selters water.	4	12.8	11.5	1.6	—0.3	The peptone was equivalent to meat and meat extract in No. 341.
343	1892	....do	....do	29	......	Same as No. 341.	4	12.6	10.4	1.9	+0.3	
344	1892	....do	Woman	19	......	200 gm. rice, 25 gm. cocoa, 300 cc. soup, 300 cc. bouillon with egg, 175 gm. meat, 30 gm. meat extract.	4	13.1	10.3	2.0	+0.8	
345	1892	....do	....do	19	......	300 cc. peptone, 200 gm. rice, 25 gm. cocoa, 300 cc. soup, 300 cc. bouillon with egg.	4	12.5	10.2	2.0	+0.3	The peptone was equivalent to meat and meat extract in No. 344.
346	1892	....do	....do	19	......	Same as No. 344.	4	12.5	8.7	2.6	+1.2	
347	1892	....do	Woman	29	......	250 gm. rice, 500 gm. milk, 300 gm. soup, 300 gm. bouillon, 175 gm. meat, 36 gm. meat extract.	3	14.6	12.4	0.8	+1.4	
348	1892	....do	....do	29	......	300 cc. peptone, 250 gm. rice, 500 gm. milk, 300 gm. bouillon.	4	14.4	13.3	0.9	+0.2	The peptone was equivalent to meat and meat extract in No. 347.

Nos. 339, 340. Deutsch med. Wochenschr., 1889, p. 27. Nos. 341-346. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. I, p. 64. Nos. 347, 348. Ibid., p. 66.

Nos. 339, 340 were made by Munk in Berlin in 1888 (?). The object was to investigate the nutritive value of Antweiler's "gelatin-free peptone," an albumose peptone. This preparation is obtained by digesting meat which contains nc fat with the juice of papaw (*Carica papaya*). The subject was a man 31 years old, weighing 61.1 kilograms.

The food in these experiments consisted of bread, meat, butter, broth, and peptone. In one experiment no peptone was consumed, but an equivalent amount of meat was substituted for it. Less broth was then used, since the meat contained considerable moisture. The nitrogen in the food, urine, and feces was determined.

The conclusion is reached that this peptone is very nearly as nutritious as meat and is somewhat more completely digested. No bad effects were noticed when the peptone was consumed.

Nos. 341–348 were made by Deiters, in von Noorden's laboratory in Berlin, in 1891. The object was to compare peptones with meat in a dietary to determine whether the nitrogen of peptones could be substituted for the proteid nitrogen of meat. Peptones are normally found in the body. The gastric juice converts the protein of the food into peptones (albumoses being formed as an intermediate step). Peptones are soluble in water and will diffuse through animal membrane. They are therefore in a condition to be assimilated. It was assumed that peptones, even if obtained by artificial methods, could be assimilated and prove of value in many cases where through illness, weakness, or other cause the power of digestion was impaired.

The subjects of the experiments were 2 women, one suffering from a slight hysterical affection and the other from a slight attack of rheumatism. In neither case was the illness sufficient to affect metabolism. The subjects were kept in bed to insure a uniform condition throughout the experiment. The experiments were divided into either 2 or 3 periods. In the first period the food consisted of meat, meat extract, rice, etc. In the second period an equivalent amount of peptone was substituted for the meat and meat extract, the other food articles remaining the same as in the first period. In the third period the diet was the same as at first. The food was prepared with great care and every precaution was taken in collecting the excretory products. The food, urine, and feces were analyzed.

Denaeyer's sterilized meat peptone, which was used in these experiments, is prepared from beef by digesting it with pepsin and hydrochloric acid. It is a clear, jelly-like liquid, of a light yellow color and an odor somewhat resembling that of bouillon. It has a slightly bitter taste, which it loses, however, when taken in soup, rice, or other medium. According to the manufacturer's analysis the composition is as follows:

Composition of Denaeyer's sterilized meat peptone.

	Per cent.
Water	80.20
Dry matter	19.80
Gelatin	.59
Albumins	.12
Albumoses	5.99
Pure peptone	5.00
Nitrogenous extractives	6.09
Nitrogen-free extract	.37
Mineral matter	1.66
Nitrogen of extractives	1.02
Albuminoid and colloid nitrogen	1.86

It will be noticed that the albumoses and pure peptone comprise 55 per cent of the total dry matter.

Von Noorden also determined the dry matter, total nitrogen, and nitrogenous extractives. His results agree with those of Denaeyer.

In the above experiments the sterilized meat peptone was eaten readily, although large quantities (300 cubic centimeters per day) were given. It was well assimilated, the same amounts of nitrogen being excreted whether peptone or meat was consumed. In the author's opinion this peptone can be substituted for the protein of meat, even if the quantity of the latter is insufficient for the needs of the organism.

The author quotes at length the experiments of previous investigators.

EXPERIMENTS TO DETERMINE THE AMOUNT OF PROTEIN REQUIRED.

In Table 6 are included 49 tests with men to study the amount of protein actually required by persons of various occupations and under various conditions.

Food performs two functions in the body. It is used to build tissue and to yield energy. While protein, fat, and carbohydrates are all sources of energy, protein alone is a tissue former. The amount of protein, in combination with fat and carbohydrates, in the so-called dietary standards has usually been determined by studies of the kind and amount of food consumed. The amount of protein which is required for the needs of the body can not be learned from dietary studies alone. In determining this factor experiments in which the balance of nitrogen or nitrogen and carbon is determined are of great value. The quantity of protein required has been shown to be dependent in great measure upon the amount of fat and carbohydrates in the dietary. The simplest form in which a diet may be expressed is in terms of protein and energy, since theoretically protein, fat, and carbohydrates can replace each other as sources of energy in the ratio of 1:4.5:1. There is, however, a limit beyond which this is not possible. A definite amount of protein is absolutely essential. The minimum quantity which serves in the adult organism for the repair of nitrogenous tissue, or other purpose not so well understood, has been variously estimated by different observers. It doubtless varies with the kind and amount of work performed. The idea has been advanced that although it is possible to sustain life and perform a considerable amount of work on a diet containing a very small amount of protein and correspondingly large amounts of carbohydrates and fat, a man is actually better nourished when the nutrients are in about the proportions suggested by the commonly accepted dietary standards. This theory rests on the supposition that the dietary standards may be learned by observing the relative amounts of nutrients actually consumed by a large number of individuals so situated that the choice of food is unrestricted.

The amount of protein required is closely connected with the influence of muscular work on the metabolism of nitrogen (see page 118). As is pointed out in the section devoted to the influence of disease on metabolism, the normal functions of nutrients may be modified by pathological conditions.

TABLE 6.—*Experiments to determine the amount of protein required.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
349	1879	Bowie	Observer		63	60 gm. butter, 250 gm. bread, 300 gm. milk, 40 gm. sugar, 200 gm. meat, 300 gm. potatoes, 2 gm. meat extract.	2	12.6	10.4	(2.3)	—0.1	Moderate work.
350	1879	.....do	Medical student		72	.....do	2	12.6	14.4	(2.3)	—4.1	Rest.
351	1879	E. Voit (reported by Bowie).	Soldier	22	68.3	392 gm. milk, 500 gm. bread, 100 gm. butter, 140 gm. meat, 200 gm. potatoes, 1,000 cc. beer, 2 gm. meat extract.	2	13.8	12.5	(2.3)	—1.0	Do.
352	1888	Hirschfeld	Observer	24	73	Bread, potatoes, bacon, etc. (29.1 gm. protein, 135 gm. fat, 268 gm. carbohydrates, 54.2 gm. alcohol).	8	4.7	6.1	1.3	—2.7	
353	1888	.....do	.....do	24		.....do	5	4.7	5.3	1.6	—2.2	Last 5 days of No. 352.
354	1888	.....do	.....do	24		.....do	1	4.6	5.0	1.3	—1.7	Last day of No. 352.
355	1888	.....do	.....do	24		Bread, potatoes, bacon, etc. (43.5 gm. protein, 165 gm. fat, 354 gm. carbohydrates, 42.7 gm. alcohol).	8	7.0	6.6	1.6	—1.2	
356	1888	.....do	.....do	24		.....do	5	7.4	6.1	1.7	—0.4	Last 5 days of No. 355.
357	1888	.....do	.....do	24		.....do	1	7.3	5.1	1.6	+0.6	Last day of No. 355.
358	1888	.....do	.....do	24		.....do	2	7.6	5.6	1.6	+0.4	Last 2 days of No. 355.
359	1888	.....do	.....do	24		.....do	2	5.1	7.5	1.4	—3.8	First 2 days of No. 355.
360	1888	.....do	.....do	24		Egg, bread, sausage, wine, sugar (78.7 gm. protein, 69.3 gm. fat, 106.3 gm. carbohydrates, 5.2 gm. alcohol, 1,470 calories).	6	12.6	14.9	1.0	—3.3	
361	1888	.....do	.....do	24		Bread, sausage, etc. (78 gm. protein, 70.9 gm. fat, 83.5 gm. carbohydrates, 1,470 calories).	4	12.5	14.5	0.9	—2.9	First 4 days of No. 360. Rest.
362	1888	.....do	.....do	24		Bread, sausage, etc. (80.1 gm. protein, 66.1 gm. fat, 152 gm. carbohydrates, 16 gm. alcohol, 1,470 calories).	2	12.8	15.7	1.2	—3.1	Last 2 days of No. 360. Work.
363	1888	.....do	.....do	24		Bread, sausage, etc. (76.2 gm. protein, 66.4 gm. fat, 115.7 gm. carbohydrates, 16 gm. alcohol, 1,470 calories).	3	12.2	15.4	1.2	—4.4	Work.
364	1888	.....do	.....do	24		Bread, sausage, etc. (116 gm. protein, 76.3 gm. fat, 97.7 gm. carbohydrates, 1,470 calories).	3	17.9	20.6	1.2	—3.9	Ordinary occupation.
365	1889	Kumagawa	.....do	27	48	Bread, meat, etc	35	(11.3)	9.8	1.6	—0.1	European diet.
366	1889	.....do	.....do	27		484.6 gm. rice, 101.7 gm. meat, 48.2 gm. fish, miso, vegetables, etc. (90.3 gm. protein, 5.6 gm. fat, 471.9 gm. carbohydrates.)	13	14.5	12.1	2.2	+0.2	Japanese diet.

TABLE 6.—*Experiments to determine the amount of protein required*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
367	1889	Kumagawa	Observer	27	......	450 gm. rice, 84.3 gm. fish, miso, vegetables, etc. (58 gm. protein, 2.4 gm. fat, 441.7 gm. carbohydrates).	5	9.3	8.7	1.8	—1.2	Japanese diet.
368	1889	.....do	.....do	27	......	450 gm. rice, 80 gm. miso, vegetables (49.2 gm. protein, 1.9 gm. fat, 441.8 gm. carbohydrates).	5	7.1	7.1	1.7	—1.7	Japanese diet; no animal food.
369	1889	.....do	.....do	27	......	600 gm. rice, 100 gm. miso, etc. (54.7 gm. protein, 2.8 gm. fat, 569.8 gm. carbohydrates).	9	8.8	6.1	2.0	+0.7	
370	1889	Klemperer	Man	20	64.0	300 gm. bread, 300 gm. butter, 250 gm. grape sugar, 800 cc. beer, 280 cc. cognac, 333 cc. coffee, 333 cc. bouillon, — gm. calcium carbonate (33 gm. protein, 264 gm. fat, 470.4 gm. carbohydrates, 172 gm. alcohol).	1	5.3	11.7	1.3	—7.7	
371	1889	.....do	.....do	20	......	.....do	7	5.3	4.2	1.3	—0.2	
372	1889	.....do	.....do	20	......	.....do	3	5.3	3.3	1.3	+0.7	Last 3 days of No. 371.
373	1889	.....do	Man	28	......	.....do	1	5.3	6.6	1.0	—2.3	
374	1889	.....do	.....do	28	......	.....do	7	5.3	3.6	1.0	+0.7	
375	1889	.....do	.....do	28	......	.....do	3	5.3	2.9	1.0	+1.4	Last 3 days of No. 374.
376	1892	Pechsel	Observer	......	77	Butter, bread, potatoes, meat extract, etc. (39–40 gm. protein).	6	7.2	6.4	1.4	—0.6	
377	1892	.....do	.....do	......	......	.....do	2	7.1	5.4	1.6	+0.1	Last 2 days of No. 376.
378	1892	.....do	.....do	......	......	Butter, bread, potatoes, meat extract, etc. (31–33 gm. protein).	2	6.1	4.8	1.6	—0.3	
379	1893	Eijkmann	Man	20	58	Meat, eggs, etc	5	15.3	10.1	3.5	+1.7	
380	1893	.....do	Man	30	42	Meat, fish, etc	4	10.3	7.3	2.0	+1.0	
381	1893	Eijkmann	Physician	32	74	Rice, eggs, fruit, etc. (88.8 gm. protein, 82.5 gm. fat, 263.8 gm. carbohydrates, 20 gm. alcohol).	3	14.2	14.0	1.7	—1.5	European diet.
382	1893	.....do	Physician	34	76.5	Rice, eggs, fruit, etc. (106 gm. protein, 92.5 gm. fat, 283.2 gm. carbohydrates, 25 gm. alcohol).	4	17.0	14.7	1.9	+0.4	Do.
383	1893	.....do	.....do	34	76.3	Rice, eggs, fruit, etc. (114.3 gm. protein, 109.8 gm. fat, 315.7 gm. carbohydrates, 24 gm. alcohol).	4	18.3	14.5	1.6	+2.2	Do.
384	1893	.....do	Physician	28½	63	Rice, eggs, fruit, etc. (96.6 gm. protein, 53.3 gm. fat, 263 gm. carbohydrates, 21.5 gm. alcohol).	4	15.5	15.5	1.1	—1.1	Do.

385	1893	.....do	Hospital secretary..	29	54	Rice, eggs, fruit, etc. (103.8 gm. protein, 81.8 gm. fat, 304.8 gm. carbohydrates, 30.5 gm. alcohol).	4	16.6	12.0	1.9	+2.7	Do.
386	1893	.....do	Laboratory servant.	41	42.4	Rice, eggs. fruit, etc. (63.2 gm. protein, 35.4 gm. fat, 213.9 gm. carbohydrates, 28 gm. alcohol).	6	10.1	6.7	1.6	+1.8	Do.
387	1893	.....do	Physician	30	71	Rice, eggs, fruit, etc. (102.3 gm. protein, 118.2 gm. fat, 263.7 gm. carbohydrates, 17.5 gm. alcohol).	4	16.4	13.7	1.7	+1.0	Do.
388	1893	.....do	.....do	30	74	Rice, eggs, fruit, etc. (78.3 gm. protein, 91.3 gm. fat, 267.5 gm. carbohydrates, 21 gm. alcohol).	4	12.5	11.5	2.1	—1.1	Do.
389	1893	.....do	Physician	30	81.3	Rice, eggs, fruit, etc. (141.4 gm. protein, 129.2 gm. fat, 198 gm. carbohydrates, 48 gm. alcohol).	4	22.6	17.5	2.4	+2.7	Do.
390	1893	.....do	.....do	30	82	Rice, eggs, fruit, etc. (136.1 gm. protein, 140.1 gm. fat, 200.5 gm. carbohydrates, 47.5 gm. alcohol).	4	21.8	19.8	1.9	+0.1	Do.
391	1893	.....do	Laboratory servant.	30	42.3	Rice, fruit, etc. (64.4 gm. protein, 22.6 gm. fat, 396.8 gm. carbohydrates).	4	10.3	7.3	2.0	+1.0	Malay diet.
392	1893	.....do	Laboratory servant.	25	47.4	Rice, fruit, etc. (59.9 gm. protein, 21 gm. fat, 398.5 gm. carbohydrates).	6	9.5	7.3	2.9	—0.7	Do.
393	1893	.....do	Medical student	20	58.1	Rice, fruit, etc. (95.9 gm. protein, 63.8 gm. fat, 425.9 gm. carbohydrates).	5	15.3	9.8	3.5	+2.0	Do.
394	1893	.....do	Laboratory servant.	35	49.4	Rice, fruit, etc. (74.3 gm. protein, 17.8 gm. fat, 555.3 gm. carbohydrates).	4	11.9	9.9	2.4	—0.4	Do.
395	1893	.....do	Laboratory servant.	25	51	Rice, fruit, etc. (72.9 gm. protein, 25.9 gm. fat, 587.9 gm. carbohydrates).	4	11.7	8.3	3.1	+0.3	Do.
396	1894	Lapicque and Marette.	Man	25	65.8	170 gm. rice, 1,000 cc. milk, bread, etc. (2,732 calories).	9	9.0	7.4	1.8	—0.2	
397	1894	.....do	Man	30	73	170 gm. rice, 1,000 cc. milk, bread, 500 cc. wine (52 gm. alcohol, 3,008 calories, without alcohol 2,634 calories).	7	9.0	6.7	1.0	+1.3	

Nos. 349–351. Ztschr. Biol., 15, p. 476. Nos. 352–354. Virchow's Arch., 114, p. 307. Nos. 355–359. Ibid., p. 310. Nos. 360–362. Ibid., pp. 317, 319. No. 363. Ibid., p. 320. No. 364. Ibid., pp. 321. No. 365. Ibid., 116, p. 381. No. 366. Ibid., p. 394. No. 367. Ibid., p. 399. No. 368. Ibid., p. 402. No. 369. Ibid., p. 406. Nos. 370–375. Ibid., p. 362. Nos. 376–378. Untersuchungen über den Eiweissbedarf des gesunden Menschen. Inaug. Diss., Berlin, 1890, p. 25. Nos. 379, 380. Virchow's Arch., 131, pp. 170, 171. Nos. 381–390. Ibid., 133, pp. 132–140. Nos. 391–395. Ibid., pp. 142–156. Nos. 396, 397. Compt. Rend. Soc. Biol., 10. ser, 1894, I, p. 274.

Nos. 349–351. Experiments Nos. 349 and 350 were made by Bowie in the laboratory of the Physiological Institute in Munich in 1879. The object was to investigate the amount of protein actually required by a man at moderate labor. The subjects were the observer and another student of medicine. The food was a simple mixed diet which included meat, bread, butter, potatoes, and milk. The composition of the food was computed from reliable data. The nitrogen in the urine was determined, and on the basis of Pettenkofer and Voit's investigations that in the feces was assumed to be 2.3 grams. The subject in No. 349 worked in the laboratory during the experiment. The subject of No. 350 kept as quiet as possible. Both men felt considerable hunger. The dietaries were so arranged as to contain the quantity of protein which, from the work of Ranke and Benecke, was considered to be just sufficient for the needs of each of the subjects. Ordinarily they were accustomed to consume more.

Bowie had determined the amount of nitrogen per day in the urine of 8 men who selected their own food, which was of the kind and amount to which they were accustomed. In this work no analyses of food were made, as the purpose was merely to form an idea of the amount of protein required, judging from the amount of nitrogen excreted in the urine.

In addition to his own work, Bowie quotes an experiment, No. 351, made in Munich in 1879 by E. Voit. The subject was a young soldier. At the time of the experiment, which lasted two days, he was doing no work. The food was a simple mixed diet, including bread, meat, butter, milk, etc.

Bowie's principal conclusion is that Voit's figure, 118 grams of protein per day for a man at moderate work, is not too high. The article contains many references to previous work.

Nos. 352–364 were made by Hirschfeld in the Pathological Institute at Berlin in 1888 (?). The object was an investigation of the amount of protein actually required by man. The observer himself was the subject. He was 1.73 meters tall and of medium weight. The food was a mixed diet. In Nos. 352–359 it consisted of potatoes, bread, butter, bacon, sugar, beer, coffee, and wine or brandy. Most of the articles were analyzed. The composition of some, for instance butter, was computed from previous analyses. In Nos. 360–364 the food consisted of cervelat sausage, cheese, bread, sugar, coffee, and sometimes wine. The sausage and cheese were procured in large quantities and the nitrogen and fat determined. The urine and feces were analyzed. The diet is expressed in terms of protein, fat, carbohydrates, alcohol, and energy. In Nos. 352–354 the amount of protein consumed was very small and the total energy of the diet was about 2,852 calories. The organism lost nitrogen throughout the period, but less upon the last days than at first. In Nos. 355–359 the amount of protein was much larger, and the fuel value of the dietary was about 3,462 calories. On the first days the organism lost considerable nitrogen. The amount became less each day until nitrogen equilibrium was reached, and on the last two days of the experiment there was a slight gain. The subject lost about 400 grams in weight. The amount of protein in these experiments is much below Voit's normal (118 grams), yet the subject remained in nitrogen equilibrium.

In Nos. 360–364 the amount of protein was ample, but the fat and carbohydrates were insufficient. In No. 360 the fuel value of the diet was 1,470 calories. This is the sort of dietary which is employed when the attempt is made to remove superfluous fat. In these experiments the attempt was also made to observe the effect of muscular labor on metabolism. For 4 days the subject remained perfectly quiet in his room, then on 2 days he took long walks. No definite conclusions were drawn.

In No. 363 the fuel value of the diet was 1,400 calories. The work done consisted largely of walking. In No. 364 the amount of protein was still more abundant and the fuel value of the diet was about 1,573 calories. The ordinary laboratory duties were the only work performed. In all these experiments the organism lost nitrogen, losing more when work was performed than when the subject remained quiet.

The following conclusions are drawn: When an organism which has little fatty tissue is supplied with an insufficient diet the protein and fat of the tissues are both

drawn upon, but the deficiency in fuel value of the diet is largely made up from the fat of the organism. The excretion of uric acid is normal, the excretion of sulphuric acid is greatly increased, and that of ether sulphuric acid very little increased.

All the methods of removing superfluous fat from the organism agree in general in supplying a very small ration. These experiments would not warrant the conclusion that an abundance of protein in such cases increases very greatly the metabolism of fat. When the supply of protein was 170 grams per day it was impossible to prevent the organism from metabolizing protein of the tissues. In a diet of the sort consumed the organism does not store up the small amount of fat and carbohydrates supplied and live entirely upon protein. If such were the case in order to obtain sufficient energy a much greater quantity of protein would have to be metabolized than was actually the case. It was not possible to judge whether or not corpulent persons could metabolize fat and no protein.

Nos. 365–369 were made by Kumagawa in the laboratory of the Pathological Institute in Berlin in 1887–88. The object was a comparison of a mixed and a vegetable diet, with special attention given to the amount of protein required by man. The investigator himself was the subject; he weighed 48 kilograms and was 1.54 meters tall.

The investigator, though a Japanese, had eaten European food during the preceding three years. With an idea, therefore, of finding the amount of protein he ordinarily consumed with this diet, the urine and feces were collected for 35 days and the nitrogen in each was determined. The nitrogen in the food was not determined. The amount of protein ordinarily consumed was calculated from the excreted nitrogen to be 70.4 grams. This is considerably less than Voit's figure, 118 grams.

For the experiments with a dietary containing small amounts of protein, Japanese food was selected. In No. 366 the food was rice, meat or fish, turnips, onions, eggs, miso, schoyu (a kind of sauce), tea, beer, and water. This dietary furnished 90.3 grams of protein, 5.6 grams of fat, and 471.9 grams carbohydrates daily. More nitrogen was evidently consumed in this experiment than in No. 365, but it was not as well assimilated, as is shown by the greater amount in the feces. In No. 367 a dietary containing less protein was followed. It consisted of rice, fish, turnips, miso, schoyu, beer, tea, and water. This dietary was not followed until nitrogen equilibrium was reached. The daily loss of nitrogen, however, was small. In No. 368 the food was entirely vegetable, consisting of rice, turnips, miso, etc. A very little nitrogen was lost daily. In No. 369 the same food as in No. 368 was used, except that the quantity was greater. The organism stored up a small amount of protein. In these experiments the nitrogen in the food was generally determined and the urine and feces were always analyzed.

The conclusion was reached that it is only essential that the diet furnish the organism with the necessary number of calories of heat, and except for a small amount of protein it is immaterial which sort of nutrients supply this energy.

Another conclusion is that a man can exist and even store up nitrogen from a dietary which contains less than the amount excreted during hunger. The author is of the opinion that a large amount of protein in the diet does not increase the amount of protein in circulation, though it does increase the amount of protein cleavage products. This might not be of advantage to the organism.

The opinion of Mori, that the diet of the larger part of the Japanese, which is principally composed of vegetable food, is not sufficient for an organism from which work is expected, is not sustained. The author's opinion is that Mori did not use enough carbohydrates in his investigations to make up for the small amount of protein.

Nos. 370–375 were made by Klemperer in 1888 to study the amount of protein actually required. The subjects were two young men. The food consisted of bread, butter, grape sugar, and bouillon. Beer and cognac were also consumed, and after each meal a little calcium carbonate was taken. Both subjects followed this diet for 8 days. On the first day there was a considerable loss of nitrogen. This loss was smaller on the second and succeeding days, and on the last 3 days in each experiment there was a slight gain of nitrogen, showing that the organism utilized

the large amount of fat and carbohydrates in place of protein. In the author's opinion strong, healthy persons may maintain nitrogen equilibrium on a diet containing 30 to 40 grams of protein daily when the assimilation of large quantities of fat and carbohydrates is assisted by the consumption of alcohol and calcium carbonate. He does not advocate the idea that healthy individuals should abandon a diet which contains considerable protein. He believes rather that Voit's normal figure represents the amount which is best suited to the needs of a healthy man. In disease, however, the case is different. The object then is not to supply a diet calculated to maintain a high protein level, which is only possible when the nitrogen excretion is also large, but rather to help the organism to gain new protein. This is possible only when the nitrogen excretion is reduced to the minimum. The metabolism of nitrogen is increased by disease. The author attempted to reduce it by a proper dietary in experiments with an invalid. Other questions of a similar nature were studied. The results, however, were not given in such form as to be available for these tables.[1]

Nos. 376–378 were made by Pechsel in Berlin in 1890, under the direction of von Noorden. The object was to study the amount of protein actually required by a healthy man. Voit considered this to be 118 grams per day for a man under normal conditions and with a diet which contained an abundance of fat and carbohydrates. Later investigators, notably Rubner, F. Hirschfeld, Kumagawa, and Klemperer, were of the opinion that a much smaller amount—30 to 40 grams per day—was sufficient to maintain the nitrogen equilibrium.

Rubner's work[2] was of especial value. He found that, according to their fuel value, the various nutrients could be substituted the one for the other. Thus, 100 grams fat = 240 grams starch = 249 grams sugar = 770 grams fresh muscle flesh free from fat. There was this limitation, however: Some protein was necessary to repair the waste of nitrogenous tissue which is continually going on and to make up for the loss of portions of the epidermis, hair, nails, epithelial cells, etc.

Pechsel's investigations were undertaken to determine this necessary amount of protein. He himself was the subject. The food consisted of bread, rice, potatoes, butter, sugar, tea, etc., but no meat. The food, urine, and feces were analyzed.

With a diet furnishing 39 to 40 grams of protein daily, nitrogen equilibrium was reached on the fifth day; that is, the income was sufficient for the needs of the organism. There was an abundance of fat and carbohydrates in the dietary, so that the organism was supplied with about 3,640 calories of energy.

The supply of protein was now reduced to 32 grams, and though sufficient fat and carbohydrates were consumed to furnish about 3,600 calories, yet the organism continued to lose nitrogen. The conclusion is reached, therefore, that 32 grams of protein is less than the smallest quantity with which a person of Pechsel's weight, 77 kilograms, could hold his own.

These experiments are too few to draw general conclusions from, but it is evident that Voit's value, 118 grams, is far above the amount of protein absolutely required, provided the dietary contains an abundance of carbohydrates and fat.

Nos. 379, 380 were made by Eijkmann in the Physiological Institute at Weltevreden (Batavia) in 1892 (?). The experiments formed part of an extended investigation of the quantity of protein required by persons living in the tropics and the influence of tropical climate on metabolism and on the production of heat. The subjects were healthy young men—Malays. The food is not described with much detail. It consisted of meat and eggs, or meat and fish, with vegetable food, probably rice. The nitrogen in many of the food articles was determined. In other cases it was calculated from König's tables. The nitrogen in the urine and feces was determined. In No. 379 analysis showed that about 40 per cent of the consumed nitrogen came from meat

[1]In a later publication (Ztschr. klin. Med., 16, 1889, p. 550) these experiments are reported in detail. With one exception (No. 558, Table 8) they were omitted from the compilation by an oversight.

[2]Ztschr. Biol., 19, 1883, p. 313.

and eggs. In No. 380, 40 per cent of the nitrogen consumed came from meat and fish. In addition to these, a large number of experiments were made in which only the urine or the food and urine were taken into account. In the latter case the dietary is expressed in terms of protein, fat, and carbohydrates.

In the investigator's opinion, the Europeans who live in the tropics do not consume less food than those living in temperate climates and performing the same amount of work, nor is the metabolism of the nutrients diminished. The fact that in the tropics less animal food is consumed than in Europe is attributed to the fact that the meats are usually prepared in such a way that they are not very appetizing.

The ration served to European soldiers in three garrisons in Batavia is given as follows. It is probable that the food is generally all consumed.

Ration of European soldiers in Batavia.

	Protein.	Fat.	Carbohydrates.
	Grams.	*Grams.*	*Grams.*
No. 1	137.5	103.0	504.4
No. 2	128.4	55.1	493.3
No. 3	142.8	79.0	491.6
Average	136.2	79.0	496.3

Using Rubner's values, the author calculated that the diet furnished about 3,000 calories. The average dietary of 8 young Malays was found to contain 75 grams protein, 40 grams fat, and 400 grams carbohydrates, equal to 2,300 calories. The average weight of the individuals was 50 kilograms. They were from the better classes. The house servants, or such persons, weighing perhaps 55 kilograms, consumed about 600 grams of rice per day and a very little animal food.

A number of experiments were made concerning the relative amount of nitrogen excreted by newcomers, by Europeans who have lived a long time in the tropics, and by the native Malays. The European subjects were young physicians or apothecaries. The Malays were medical students. The European dietary consisted of rice cooked with condiments and vegetables, bread, cheese, fruit, and highly-seasoned dishes made from meat or eggs. This is a modification of the native diet. The Malay diet is more simple, consisting per day of 800 to 1,200 grams of boiled rice, 150 to 200 grams of ducks' eggs, 60 grams of meat or fish, 150 to 250 grams of pastry rather free from fat, and fresh fruit. Europeans who had been in the country from 2 to 6 months excreted 14.8 grams nitrogen per day, or 0.226 grams per kilogram (average of 6 experiments). Those who had lived in the tropics 1½ to 15 years excreted 12.802 grams nitrogen per day, or 0.193 grams per kilogram (average of 12 experiments). The Malays excreted 7.817 grams per day, or 0.153 per kilogram (average of 8 experiments). The smaller nitrogen excretion in the latter case is probably partly due to the fact that less animal food is consumed and that the Malays are generally of smaller stature than the Europeans.

Several experiments were made to determine the amount of nitrogen excreted in the perspiration. The subjects were thoroughly washed and rinsed in distilled water. They were then clothed in cotton or woolen garments, which were frequently changed. The hands and face were also frequently wiped with a towel. At the end of the experiment the body was washed with alcohol and distilled water, to remove all adhering perspiration. The perspiration absorbed in the garments and towels was extracted with acidulated water and then with pure water. The nitrogen was determined in the water after it had been partially evaporated. The first experiment lasted 3 hours, and 0.222 gram of nitrogen was excreted. The second experiment lasted 24 hours; the nitrogen in the perspiration was 0.761 gram, in the urine 12.159 grams. The third experiment lasted 24 hours; in the perspiration the nitrogen excretion was 1.362 grams, in the urine 14.250 grams. The subjects engaged in some light occupation.

The article contains a somewhat extended historical account of the work on metabolism.

Nos. 381–395 were made by Eijkmann in Batavia in 1892. They were a continuation of Nos. 379 and 380, and had the same objects in view. The subjects were 7 Europeans and 5 Malays. The average age of the Europeans was 32 years and they had been in the East from 4½ to 15 years, or an average of 7 years. The average weight was 65.4 kilograms. The average weight of the Malays was 49.6 kilograms. The European subjects were physicians or were occupied in some way in one of the hospitals. The work which they performed was very moderate. The Malays were hospital or laboratory servants, with the exception of one, who was a student of medicine.

The food of the Europeans was a European diet, but modified by the customs of the country in which they lived, and consisted of bread, cheese, meat or eggs in some form, vegetables and fruit, and an abundance of rice. Alcohol in some form was also used, and considerable tea, coffee, and ice water were consumed. Most of the Europeans adopt the native custom of eating large quantities of rice. The Malays consumed a somewhat similar diet, consisting largely of fruit, vegetables, and rice cooked with red pepper. The diet of the Europeans contained on an average 99.6 grams of protein, 83.8 grams of fat, 264.2 grams of carbohydrates, 20.5 grams of ash, 28.5 grams of alcohol, and furnished 2,470 calories. The diet of the Malays contained 73.3 grams of protein, 30.2 of fat, 471.9 of carbohydrates, 16.3 of ash, and furnished 2,512 calories. The native diet contains considerably less protein than the European and the protein was more largely of vegetable origin. The food of the Malays was purchased at native cook shops and cost per day about 0.2 florin, or 8 cents. Portions of the food of the Europeans and Malays were taken for analysis, and the dry matter, nitrogen, fat, and ash in the food and feces and the nitrogen of the urine were determined.

In these investigations no regular change could be noticed in the production of heat or in the metabolism of Europeans performing light labor after long residence in the tropics. The article contains considerable discussion of the subject from an historical standpoint.

Nos. 396, 397 were made by Lapicque and Marette at the Hotel Dieu, in Paris, in 1893 (?). The object was to study the amount of nitrogen in the food which was really necessary to maintain nitrogen equilibrium. The subjects were two young men. The diet consisted principally of rice and milk. In addition a little bread, butter, sugar, and fruit were consumed. In No. 396 tea was drunk, and in No. 397 half a liter of wine with water was used per day. The nitrogen and the fat in the butter, the water in the bread, and the alcohol in the wine were determined. The composition of the other foods was calculated from König's tables. The author states that protein was obtained by multiplying nitrogen by 6.5. However, it would appear that this factor was not used in the calculation, but rather 6.4. No reason is given for using 6.5 instead of the ordinarily accepted factor 6.25. The nitrogen in the urine and feces was determined by the Kjeldahl-Henninger method.

The following conclusions were reached: The organism can be maintained in nitrogen equilibrium, or very nearly so, with the small quantity consumed in this experiment. It is believed that the energy of alcohol is utilized in the same way as that of other nutrients. The details as published are not very full.

MISCELLANEOUS EXPERIMENTS ON THE INFLUENCE OF DIET.

In Table 7 are included 125 tests with men, 4 with women, and 12 with children, which could not be included in the preceding tables. In some few experiments special questions were studied; for instance, the effect of consuming food in small amounts at frequent intervals. In the majority of cases the balance of nitrogen was determined in connection with dietary studies.

TABLE 7.—*Miscellaneous experiments on the influence of diet.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
398	1862	Ranke	Observer	24	70.1	Mixed diet	1	17.9	24.0	1.7	— 7.8	
399	1862	...do	...do	24	70.75	250 gm. meat, 400 gm. bread, 100 gm. eggs, 150 gm. potatoes, 40 gm. butter, 60 gm. fat, — gm. salt, 1,700 cc. water.	8	17.9	19.0	1.7	— 2.8	
400	1862	...do	...do	24	71	Mixed diet	1	25.1	20.3	2.6	+ 2.2	
401	1862	...do	...do	24	......	500 gm. beef, 200 gm. bread, 15 gm. fat, 10 gm. salt, 2,000 cc. water.	7	19.6	21.9		— 2.3	
402	1862	...do	...do	24	......	250 gm. beef, 400 gm. bread, 70 gm. starch, 70 gm. white of egg, 70 gm. fat, 30 gm. butter, 10 gm. salt, 2,100 cc. water.	8	15.2	14.9	1.1	— 0.8	
403	1862	...do	......	24	......	Mixed diet	3	19.6	18.5	1.2	— 0.1	Last 3 days of No. 402.
404	1862	...do	Observer	24	......	...do	11	20.4	22.4		— 2.0	
405	1862	...do	...do	24	68.6	200 gm. meat, 80 gm. fat, 14 gm. salt, 1,400 gm. water	1	66.3	55.7	8.2	+22.4	
406	1862	...do	...do	24	71.1	1,281 gm. meat, 78 gm. fat, 2,000 gm. water	1	43.6	32.9	5.0	+ 5.7	
407	1868	Siewert	Observer	......	56	500 gm. beef, 90 gm. bread, 300 gm. potatoes, 25 gm. butter, 20 gm. sugar, 8 gm. salt, 2,250 cc. beer, 500 cc. coffee, 500 cc. water, 580 cc. soup.	12	21.3	17.5	3.1	+ 0.7	
408	1868	...do	...do	......	......	500 gm. horse meat, 90 gm. bread, 300 gm. potatoes, 25 gm. butter, 20 gm. sugar, 8 gm. salt, 2,250 cc. beer, 500 cc. coffee, 500 cc. water, 580 cc. soup,	10	19.1	15.8	2.8	+ 0.5	CaO in food 1.1 gm., in urine 0.2 gm., in feces 1 gm.; loss, — 0.1 gm. P_2O_5 in food 4.9 gm., in urine 3.3 gm., in feces 1.7 gm.; loss, — 0.1 gm. Cl in food 5.6 gm., in urine 6.7 gm., in feces, 0; loss, 1.1 gm. NaO in food 6.8 gm., in urine 4.6 gm., in feces, 0.3 gm.; gain, 1.9 gm. KO in food 6.9 gm., in urine 5.6 gm., in feces 0.8 gm.; gain, 0.5 gm.

TABLE 7.—*Miscellaneous experiments on the influence of diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (−).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
409	1868	Siewert	Observer			500 gm. horse meat, 90 gm. bread, 500 gm. potatoes, 90 gm. butter, 20 gm. sugar, 2 gm. salt, 2,250 cc. beer, 900 cc. coffee, 500 cc. water, 45 gm. mustard.	10	19.4	15.7	2.6	+ 1.1	CaO in food 1.0 gm., in urine 0.2 gm., in feces 0.1 gm.; gain, 0.7 gm. P_2O_5 in food 5.4 gm., in urine 3.1 gm., in feces, 2.3 gm.; gain or loss 0. Cl in food 9 2 gm., in urine 8.0 gm., in feces 0; gain, 1.2 gm. NaO in food 11.3 gm., in urine 5.8 gm., in feces 0.2 gm.; gain 5.3 gm. KO in food 8.2 gm., in urine 6.7 gm., in feces 1.0 gm.; gain, 0.5 gm.
410	1877	Forster	Laboratory servant	60		Bread, meat, sugar, milk, etc	3	18.7	17.0	2.3	− 0.6	
411	1877	Schuster	Prisoner			Soup, meat, vegetables, etc	6	16.6	11.0	4.1	+ 1.5	
412	1877	do	do			do	4	13.4	10.5	1.6	+ 1.3	
413	1879	Rubner	Laboratory servant	44		95.6 gm. bacon, 450 gm. bread, 614 gm. meat	2	23.6	23.5	2.9	− 2.8	
414	1879	do	do	44		191.2 gm. bacon, 600 gm. meat, 450 gm. bread.	2	23.5	18.3	3.3	+ 1.9	
415	1879	do	do	44		240 gm. butter, 600 gm. meat, 450 gm. bread	2	23.0	16.2	2.6	+ 4.2	
416	1879	do	do	44		145.8 gm. bacon, 233 gm. butter, 600 gm. meat, 450 gm. bread.	2	23.4	15.5	2.1	+ 5.8	
417	1879	do	Man			821 gm. cake made of starch, sugar, fat, and salt.	2	1.4	9.1	1.4	− 9.1	
418	1884	Rieder	do		70.	300 gm. starch, 120 gm. sugar, 89 gm. fat, 17 gm. baking powder, 908 cc. wine.	3	0.0	9.3	0.5	− 9.8	
419	1884	do	do		70.	90 gm. starch, 40 gm. sugar, 60 gm. fat, 11 gm. baking powder, 1,125 cc. wine.	3	0.0	9.5	0.9	−10.4	
420	1884	do	do		70.	100 gm. starch, 30 gm. sugar, 30 gm. fat, 5.7 gm. baking powder, 907 cc. wine.	3	0.0	7.2	0.8	− 8.0	
421	1887	Baftalovski	Observer	31	60.6	2,322 cc. tea and water, 135 gm. sugar, 513 gm. cutlet, 103 gm. gravy, 110.2 gm. egg (1 day), 88 gm. blackberries (1 day).	3	22.8	24.1	1.3	− 2.6	Animal food.

422	1887	.....do	.....do	31	60.5	2,815 cc. tea and water, 169 gm. sugar, 286 gm. cutlet, 106 gm. gravy, 320 gm. milk (1 day), 26 gm. plum butter, 50 gm. blackberries (1 day), 640 gm. potatoes with gravy, 463 gm. peas (1 day), 855.3 gm. sago (1 day), 325 gm. bread.	3	22.0	19.3	1.8	+ 0.9	Mixed diet.
423	1887	.....do	.....do	31	60.5	2,420 cc. tea and water, 42 gm. blackberries (1 day), 797 gm. potatoes, 360 gm. beans, 159 gm. sugar, 597 gm. rice (1 day), 902 gm pearl barley, 310 gm. bread, 25 gm. sunflower seed fat (1 day).	3	11.8	11.9	2.5	— 2.6	Vegetable food.
424	1887	.....do	Physician (G.)	42	57.1	2,040 cc. tea and water, 125 gm. sugar, 546 gm. cutlet, 285 gm. gravy, 110 gm. egg (1 day).	3	25.4	24.0	1.1	+ 0.3	Animal food.
425	1887	.....do	.....do	42	58.5	1,298 cc. tea and water, 158 gm. sugar, 305 gm. cutlet, 104 gm. gravy, 320 gm. milk (1 day), 67 gm. plum butter (1 day), 48.4 gm. blackberries (1 day), 545 gm. potatoes with gravy (1 day), 482 gm. peas (1 day), 778 gm. sago (1 day), 339 gm. bread.	3	22.9	19.2	2.1	+ 1.6	Mixed diet.
426	1887	.....do	.....do	42	58.8	1,498 cc. tea and water, 166 gm. sugar, 58 gm. blackberries (1 day), 466 gm. potatoes (1 day), 334 gm. beans, 870 gm. rice (1 day), 891 gm pearl barley (1 day), 384 gm. bread, 36 gm. sunflower seed fat (1 day).	3	13.0	11.8	2.3	— 1.1	Vegetable food.
427	1887	.....do	Medical student (L.).	24	66.1	2,250 cc. tea and water, 199 gm. sugar, 530 gm. cutlet, 234 gm. gravy, 25 gm. plum butter (1 day), 54 gm. blackberries (1 day).	3	24.9	27.0	0.7	— 2.8	Animal food.
428	1887	.....do	.....do	24	66.5	1,973 cc. tea and water, 137 gm. sugar, 272 gm. cutlet, 93 gm. cheese, 480 gm. manna gruel (1 day), 313 gm. turnip, 48 gm. blackberries (1 day), 615 gm. white bread.	3	29.4	25.1	2.2	+ 2.1	Mixed diet.
429	1887	.....do	.....do	24	68.6	2,067 cc. tea and water, 116 gm. sugar, 44 gm. blackberries (1 day), 563 gm. white bread, 317 gm. black bread, 511 gm. peas, 661 gm. lentils (1 day), 183 gm. baked apples, 140 gm. buckwheat gruel (1 day), 12 gm. butter.	3	22.9	13.8	2.8	+ 6.3	Vegetable food.
430	1887	.....do	Medical student (P.).	20	56.3	1,580 cc. tea and water, 187 gm. sugar, 425 gm. cutlet, 211 gm. gravy, 23 gm. plum butter (1 day), 46 gm. blackberries (1 day).	3	20.4	21.7	1.3	— 2.6	Animal food.
431	1887	.....do	.....do	20	56.8	1,730 cc. tea and water, 287 gm. cutlet, 31 gm. plum butter (1 day), 115 gm. cheese, 511 gm. manna gruel (1 day), 336 gm. turnips (1 day), 52 gm. blackberries (1 day), 500 gm. black bread, 421 gm. lentils (1 day).	3	29.6	23.5	1.3	— 4.8	Mixed food.
432	1887	.....do	.....do	20	57.7	1,482 cc. tea and water, 56 gm. blackberries (1 day), 516 gm. white bread, 127 gm. black bread, 334 gm. peas, 335 gm. lentils (1 day), 181 gm. baked apples, 161 gm, buckwheat gruel, 10 gm. sunflower seed fat.	3	16.9	14.0	2.4	— 0.5	Vegetable food.

TABLE 7.—*Miscellaneous experiments on the influence of diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
433	1887	Baftalovski	Medical student (S.).	20	54.2	2,340 cc. tea and water, 348 gm. millet gruel, 953 cc. bouillon, 73 gm. butter, 471 gm. white bread, 390 gm. cutlet, 30 gm. blackberries (1 day), 19 gm. salt, 99 gm. sugar.	3	27.4	20.2	2.7	+ 4.5	Mixed diet.
434	1887	....do	....do	20	54.5	2,647 cc. tea and water, 1,719 gm. millet gruel, 693 cc. bouillon, 80 gm. butter, 30 gm. blackberries (1 day), 22 gm. salt, 105 gm. sugar.	3	5.6	8.6	2.9	— 5.9	Vegetable food (thin gruel).
435	1887	....do	....do	20	54.4	2,600 cc. tea and water, 1,221 gm. millet gruel, 780 cc. bouillon, 80 gm. butter, 30 gm. blackberries (1 day), 23 gm. salt, 105 gm. sugar.	3	6.7	5.9	4.5	— 3.7	Vegetable food (thick gruel).
436	1887	....do	....do	20	54.4	2,617 cc. tea and water, 214 gm. millet gruel, 780 cc. bouillon, 82 gm. butter, 600 gm. white bread, 370 gm. cutlet, 30 gm. blackberries (1 day), 18 gm. salt, 100 gm. sugar.	3	27.9	19.2	2.3	+ 6.4	Mixed diet.
437	1887	....do	Hospital servant (V.).	25	56.9	2.513 cc. tea and water, 298 gm. millet gruel, 1,127 cc. bouillon, 80 gm. butter, 516 gm. white bread, 386 gm. cutlet, 30 gm. blackberries (1 day), 31 gm. salt, 161 gm. sugar.	3	28.1	22.4	2.7	+ 3.0	Do.
438	1887	....do	....do	25	56.6	2,733 cc. tea and water, 1,615 gm. millet gruel, 867 cc. bouillon, 130 gm. butter, 30 gm. blackberries (1 day), 27 gm. salt, 154 gm. sugar.	3	5.6	8.9	3.2	— 6.5	Vegetable food (thin gruel).
439	1887	....do	....do	25	56.6	2,080 cc. tea and water, 809 gm. millet gruel, 867 cc. bouillon, 130 gm. butter, 30 gm. blackberries (1 day), 25 gm. salt, 153 gm. sugar.	3	4.7	5.7	2.6	— 3.6	Vegetable food (thick gruel).
440	1887	....do	....do	25	57	2,270 cc. tea and water, 321 gm. millet gruel, 520 cc. bouillon, 700 gm. white bread, 376 gm. cutlet, 30 gm. blackberries (1 day), 23 gm. salt, 150 gm. sugar.	3	29.5	16.1	2.8	+10.6	Mixed diet.
441	1887	....do	Hospital servant	38	71.5	1,560 cc. tea and water, 349 gm. millet gruel, 1,040 cc. bouillon, 80 gm. butter, 531 gm. white bread, 389 gm. cutlet, 30 gm. blackberries (1 day), 15 gm. salt, 84 gm. sugar.	3	28.4	20.1	2.4	+ 5.9	Do.

442	1887	.....do	.....do	38	73.6	2,340 cc. tea and water, 1,745 gm. millet gruel, 1,040 cc. bouillon, 130 gm. butter, 30 gm. blackberries (1 day), 19 gm. salt, 97 gm. sugar.	3	6.0	9.2	[illegible].7	— 6.9	Vegetable food (thin gruel).
443	1887	.....do	.....do	38	73.7	1 733 cc. tea and water, 1,229 gm. millet gruel, 867 cc. bouillon, 130 gm. butter, 30 gm. blackberries (1 day), 25 gm. salt, 103 gm. sugar.	3	6.9	5.7	3.5	— 2.3	Vegetable food (thick gruel).
444	1887	.....do	.....do	38	73	2,097 cc. tea and water, 314 gm. millet gruel, 693 cc. bouillon, 401 gm. white bread, 368 gm. cutlet, 30 gm. blackberries (1 day), 21 gm. salt, 100 gm. sugar.	3	24.3	10.7	2.6	+11.0	Mixed diet.
445	1888	Levin	Man (V.)	58	103.5	1,000 cc. tea, 242 gm. bread, 138 gm. meat, 92 gm. cheese (4 days), 92 gm. eggs (3 days), 204 gm. sausage (5 days).	12	13.9	6.5	1.2	+ 6.2	
446	1888	.....do	Man (M.)	21	90.3	1,646 cc. tea, 151 gm. bread, 159 gm. meat, 62 gm. cheese (4 days), 67 gm. eggs (2 days), 121 gm. sausage (6 days).	12	12.6	12.6	1.0	— 1.0	
447	1888	Rutgers	Man	36	55	Meat, bread, butter, potatoes, rice, sugar, etc.	1	18.5	16.5	1.5	+ 0.5	For other experiments by the author see Nos. 4-7, Table 1.
448	1888	.....do	Woman	39	49	.....do	1	12.6	11.0	0.8	+ 0.8	
449	1889	Mori	Observer	....	....	Rice, salted radish, etc	3	11.3	9.8	2.8	— 1.3	Diet of the very poor.
450	1889	.....do	.....do	....	....	1,200 gm. boiled rice, 150 gm. fish, 100 gm. salted radish, 350 gm. vegetables, etc.	3	17.5	14.4	2.2	+ 0.9	Medium diet.
451	1889	.....do	.....do	....	....	Rice, fish, meat, etc	3	19.7	18.6	1.2	— 0.1	Better diet.
452	1890	Lusk	.....do	24	60	300 gm. meat, 500 gm. zwieback, 200 cc. milk, 50 gm. butter, 21.4 gm. sugar, etc.	3	20.5	18.5	1.3	+ 0.7	
453	1890	.....do	.....do	24	....	300 gm. meat, 74.7 gm. gluten bread, 200 cc. milk, 50 gm. butter, 28.7 gm. coffee.	3	20.5	24.9	1.0	— 5.4	
454	1890	.....do	.....do	24	....	500 gm. zwieback, 50 gm. butter, 20 gm. sugar.	2	9.2	12.1	1.6	— 4.5	Diet containing no meat.
455	1890	.....do	.....do	24	....	76.8 gm. gluten bread, 50 gm. butter	2	9.2	14.6	1.2	— 6.6	Diet containing no carbohydrates or meat.
456	1890	Hultgren and Landergren.	Sailor	32	80	Fresh coarse rye bread, broth, potatoes, boiled fresh meat, salt meat, barley porridge, pea soup, thickened soup, caraway cheese, butter, coffee with sugar, skim milk (51.4 gm. fat, 550.6 gm. carbohydrates, 27.8 gm. ash).	3	24.6	18.8	5.4	+ 0.4	
457	1890	.....do	.....do	32	....	Sifted rye flour bread, salt pork, peas, caraway cheese, oat soup with apples, pea soup, beer, tea, sweetened chocolate, coffee, butter (85.3 gm. fat, 546.4 gm. carbohydrates, 30.3 gm. ash).	3	21.9	19.1	3.8	— 1.0	
458	1890	.....do	Workingman	19	65	Coarse rye flour bread, salt pork, herring, potatoes, milk (132.5 gm. fat, 557.8 gm. carbohydrates, 51.1 gm. ash).	3	25.1	22.8	6.2	— 3.9	

TABLE 7.—*Miscellaneous experiments on the influence of diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
459	1892	Buys	Workingman	60	75	50 gm. veal (1 day), 1 or 2 eggs, 30 gm. lean beef (1 day), 123 gm. bread, 200 gm. potatoes, 28 gm. butter, 2,067 cc. beer, 400 cc. coffee with milk, 500 cc. soup (272 gm. carbohydrates. 36 gm. fat).	3	7.4	6.4	(1.6)	—1.6	
460	1892	....do	....do	60	......	140 gm. veal (1 day), 1 and 3 eggs (2 days), 98 gm. bread, 200 gm. potatoes, 17 gm. butter, 2.400 cc. beer, 400 cc. coffee with milk, 500 cc. soup (219 gm. carbohydrates, 36 gm. fat).	3	8.3	6.8	(1.6)	—0.1	
461	1892	....do	....do	60	......	40 gm. veal (1 day), 26 gm. beef (1 day), 1 or 2 eggs (2 days), 121 gm. bread, 200 gm. potatoes, 50 gm. carrots (1 day), 30 gm. cabbage (1 day), 29 gm. butter, 8 gm. fat (1 day), 2,867 cc. beer, 400 cc. coffee with milk, 500 cc. soup (292 gm. carbohydrates, 39 gm. fat).	3	7.0	5.7	(1.6)	—0.3	
462	1892	Camerer	Boy III	13	......	Mixed diet (40.5 gm. fat, 246.7 gm. carbohydrates, 5.2 cc. alcohol).	24	15.3	12.8	1.2	+1.3	Ash in food 11.0 gm., in urine 12.7 gm., in feces 2.2 gm.; loss, 3.9 gm.
463	1892	....do	Girl IV	11	......	Mixed diet (28 gm. fat, 267.2 gm. carbohydrates, 3.5 cc. alcohol).	24	14.3	10.5	1.3	+2.5	Ash in food 9.3 gm., in urine 10.3 gm., in feces 2.3 gm.; loss, 3.3 gm.
464	1892	....do	Girl V	9	......	Mixed diet (27.3 gm. fat, 160.5 gm. carbohydrates, 5.6 cc. alcohol).	24	9.2	8.0	0.8	+0.4	Ash in food 7.0 gm., in urine 7.7 gm., in feces 1.8 gm.; loss, 2.5 gm.
465	1892	....do	Boy III	15	......	Mixed diet (72.7 gm. fat, 286.9 gm. carbohydrates, 26 cc. alcohol).	24	16.4	14.0	1.5	+0.9	Ash in food 15.3 gm., in urine 14.0 gm., in feces 1.9 gm.; loss, 0.6 gm.
466	1892	....do	Girl IV	13	......	Mixed diet (60.5 gm. fat, 305.5 gm. carbohydrates, 10.9 cc. alcohol).	24	11.0	8.5	1.3	+1.2	Ash in food 12.0 gm., in urine 10.5 gm., in feces 1.7 gm.; loss, 0.2 gm.
467	1892	....do	Girl V	11	......	Mixed diet (50.6 gm. fat, 242.5 gm. carbohydrates, 11.2 cc. alcohol).	24	9.1	7.1	0.9	+1.1	Ash in food 10.2 gm., in urine 9.8 gm., in feces 1.1 gm.; loss, 0.7 gm.

468	1892	....do	Girl I	23	......	Mixed diet (75.2 gm. fat, 245.2 gm. carbohydrates, 14.6 cc. alcohol).	24	11.1	9.6	1.7	—0.2	Ash in food 13.8 gm., in urine 13.5 gm., in feces 2.8 gm.; loss, 2.4 gm.
469	1892	....do	Girl II	21	......	Mixed diet (66.7 gm. fat, 238.6 gm. carbohydrates, 4 cc. alcohol).	24	10.3	9.4	1.1	—0.2	Ash in food 11.6 gm., in urine 13.9 gm., in feces 2.2 gm.; loss, 4.5 gm.
470	1892	....do	Boy III	18	......	Mixed diet (83.5 gm. fat, 302.1 gm. carbohydrates, 19.2 cc. alcohol).	24	16.0	14.1	1.3	+0.6	Ash in food 16.7 gm., in urine 16.3 gm., in feces 2.4 gm.; loss, 2.0 gm.
471	1892	....do	Girl IV	16	......	Mixed diet (59.4 gm. fat, 240.3 gm. carbohydrates, 7 cc. alcohol).	24	9.9	8.3	0.8	+0.8	Ash in food 10.2 gm., in urine 8.5 gm., in feces 1.3 gm.; gain, 0.3 gm.
472	1892	....do	Girl V	14	......	Mixed diet (70.6 gm. fat, 271.7 gm. carbohydrates, 10.2 cc. alcohol).	24	10.6	8.1	1.1	+1.4	Ash in food 11.5 gm., in urine 11.5 gm., in feces 1.9 gm.; loss, 1.9 gm.
473	1892	....do	Child	1	......	Soup, porridge from zwieback meal, egg, milk (21.4 gm. fat, 126 gm. carbohydrates).	4	5.0	3.8	0.8	+0.4	
474	1892	Oi (reported by Mori).	Man	......	......	Meat, rice, barley	......	21.6	16.4	1.2	+4.0	
475	1892	....do	....do	......	......	Fish, rice	......	20.5	17.7	0.4	+2.4	
476	1892	....do	....do	......	......	Fish, rice, barley	......	22.5	16.1	1.4	+5.0	
477	1892	....do	....do	......	......	Bean cheese	......	12.0	12.8	0.1	—0.9	
478	1892	....do	....do	......	......	Bean cheese, rice, barley	......	13.9	12.2	1.4	+0.3	
479	1892	....do	....do	......	......	Vegetables, rice	......	8.0	11.0	0.1	—3.1	
480	1892	....do	....do	......	......	Vegetables, rice, barley	......	10.0	14.1	0.2	—4.3	
481	1892	....do	Nurse	......	......	Bread, meat	12	18.1	16.6	0.5	+1.0	European diet. Average of 10 tests.
482	1892	....do	....do	......	......	Meat, rice	12	13.6	12.8	0.4	+0.4	Japanese diet. Average of 10 tests.
483	1892	Guriev	Man (R.)	68	56	1,800 cc. tea, 60 gm. sugar, 20 gm. butter, 600 gm. bread, 100 gm. meat, 250 gm. milk.	5	13.7	8.4	1.0	+4.3	
484	1892	....do	....do	68	......	1,800 cc. tea, 60 gm. sugar, 70 gm. butter, 400 gm. bread, 500 cc. beef tea, 600 gm. potatoes.	8	8.9	6.5	0.9	+2.5	
485	1892	....do	Man (S.)	74	57.2	1,200 cc. tea, 60 gm. sugar, 23 gm. butter, 600 gm. bread, 142 gm. meat, 500 gm. milk.	10	17.4	14.6	1.2	+1.6	
486	1892	....do	....do	74	......	1,200 cc. tea, 60 gm. sugar, 90 gm. butter, 500 gm. bread, 500 cc. beef tea, 300 gm. potatoes.	8	10.9	7.7	0.8	+2.4	
487	1892	....do	Man (T.)	75	54.6	2,100 cc. tea, 60 gm. sugar, 20 gm. butter, 558 gm. bread, 250 gm. milk, 100 gm. meat.	5	13.0	9.0	1.2	+2.8	
488	1892	....do	....do	75	......	2,160 cc. tea, 60 gm. sugar, 90 gm. butter, 400 gm. bread, 500 cc. beef tea, 600 gm. potatoes.	7	8.9	6.7	1.8	+0.4	
489	1892	....do	Man (L.)	88	53.5	1,530 cc. tea, 60 gm. sugar, 30 gm. butter, 600 gm. bread, 500 gm. milk, 100 gm. meat.	5	15.1	10.7	1.2	+3.2	
490	1892	....do	....do	88	......	1,530 cc. tea, 60 gm. sugar, 120 gm. butter, 340 gm. bread, 400 gm. potatoes.	5	6.7	4.3	1.1	+1.3	
491	1892	....do	Man (K.)	88	60.6	2,200 cc. tea, 60 gm. sugar, 20 gm. butter, 600 gm. bread, 250 gm. milk, 100 gm. meat.	5	13.7	10.9	1.8	+1.0	
492	1892	....do	....do	88	......	2,200 cc. tea, 60 gm. sugar, 90 gm. butter, 400 gm. bread, 500 cc. beef tea, 600 gm. potatoes.	8	8.9	8.1	1.4	+0.6	

TABLE 7.—*Miscellaneous experiments on the influence of diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
493	1893	Kayser	Observer	23	67	500 gm. meat, 200 gm. cakes, 39 gm. butter, 100 gm. rice, 18.3 gm. oil, 23 gm. vinegar salad (lettuce?), 100 gm. sugar, 6 gm. tea, 1,040 gm. water, 940 gm. Furstenbrun water (71 gm. fat, 338 gm. carbohydrates, 2,580 calories).	4	21.2	18.9	1.3	+1.0	
494	1893	....do	....do	23	......	......	1	21.3	20.1	1.3	—0.1	Last day of No. 493.
495	1893	....do	....do	23	......	400 gm. meat, 278 gm. egg, 157.6 gm. butter, 50.3 gm. oil, 25 gm. vinegar salad (lettuce?), 6 gm. tea, 640 gm. water, 904 gm. Furstenbrun water (220 gm. fat, 0 carbohydrates, 2,004 calories).	3	21.6	23.5	1.1	—3.0	
496	1893	....do	....do	23	......	......	1	21.6	25.4	1.1	—3.9	Last day of No. 495.
497	1893	....do	....do	23	......	475 gm. meat, 200 gm. cakes, 100 gm. rice, 39 gm. butter, 18.3 gm. oil, 25 gm. vinegar salad (lettuce?), 1,040 gm. water 940 gm. Furstenbrun water.	3	21.1	19.3	0.9	+0.9	
498	1893	....do	....do	23	......	......	1	21.1	18.8	0.9	+1.4	Last day of No. 497.
499	1893	Manfredi	Shoemaker	......	......	Soup, fish, vegetables, etc	5	11.5	9.5	1.7	+0.3	
500	1893	....do	....do	......	......	....do	5	12.7	10.6	2.2	—0.1	
501	1893	....do	Peddler (woman)	......	......	....do	3	9.3	7.7	1.3	+0.3	
502	1893	....do	Carpenter	......	......	....do	7	15.0	11.6	3.1	+0.3	
503	1893	....do	Peddler	......	......	....do	4	10.1	6.8	3.1	+0.2	
504	1893	....do	Mason	......	......	....do	5	11.3	8.0	3.0	+0.3	
505	1893	....do	Beggar	......	......	....do	4	10.5	9.2	1.4	—0.1	
506	1893	....do	Peddler (woman)	......	......	....do	5	9.7	8.1	1.6	0.0	
507	1893	....do	......	......	......	....do	......	11.2	8.9	2.2	—0.1	Average of Nos. 499–506.
508	1893	Dapper	Observer	29	100	Meat, eggs, cakes, bread, beer, brandy, etc. (120 gm. protein, 65 gm. fat, 46 gm. carbohydrates, 27.4 gm. alcohol).	20	19.2	17.8	1.3	+0.1	
509	1893	....do	....do	29	......	400 gm. meat, 45 to 135 gm. egg, 30 gm. cakes, 50 gm. bread, butter, oil, etc.).	8	17.3	17.1	1.4	—1.2	First eight days of No. 508.
510	1893	....do	....do	29	......	500 gm. meat, 140 to 185 gm. egg, cakes, etc. (129 gm. protein, 64.3 gm. fat, 38.3 gm. carbohydrates, 27 gm. alcohol).	12	20.4	18.3	1.3	+0.8	Last twelve days of No. 508.

511	1893	....do	....do	29	......	Caviar, meat, cakes, butter, oil, salad, beer, cognac, etc. (173.6 gm. protein, 80.4 fat).	12	27.6	25.3	1.6	+0.7	
512	1893	....do	....do	29	......	Meat, cakes, white bread, 35 gm. jelly, 10 gm. butter, 100 gm. salted cucumber (*salz gurke*), potatoes, beer, cognac, coffee, water.	18	22.0	21.1	1.9	—1.0	Nitrogen in urine and feces was determined 17 days only.
513	1893	Krug	Observer	24	59	Cocoa, sugar, butter, bread, sausage, meat, eggs, fruit, 2,200 gm. water (151.6 gm. fat, 193.1 gm. carbohydrates, 2,575 calories).	6	14.6	11.8	2.8	0.0	
514	1893	....do	....do	24	......	Cocoa, sugar, butter, bread, caviar, macaroni, cakes, etc. (227.2 gm. fat, 425.2 gm. carbohydrates, 4,284.7 calories).	15	15.5	9.6	2.5	+3.4	
515	1894	Albertoni and Novi	Woman	......	......	1,723.1 gm. polenta, soup, herring, fat	3	14.8	13.0	3.0	—1.2	
516	1894	....do	Man	39	......	1,382.5 gm. polenta, soup, herring, fat	3	11.2	9.3	2.5	—0.6	
517	1894	....do	Boy	14	......	884 gm. polenta, soup, herring, fat	3	8.9	7.2	0.8	+0.9	
518	1894	....do	Man	39	......	762.7 gm. bread, fish, soup, melon, cheese	3	24.5	17.0	2.1	+5.4	
519	1894	....do	Woman	......	......	567.2 gm. bread, fish, soup, melon, cheese	3	19.4	11.6	2.2	+5.6	
520	1894	....do	Boy	14	......	358.5 gm. bread, fish, soup, melon, cheese	3	14.1	6.6	1.7	+5.8	
521	1894	Von Limbeck	Woman	79	......	Mixed diet	6	......	......	......	......	CaO in food 0.6 gm., in urine 0.1 gm., in feces 1.7 gm.; loss 1.2 gm.
522	1894	....do	....do	81	......	....do	6	......	......	......	......	CaO in food 0.6 gm., in urine (0.03) gm., in feces 1.4 gm.; loss 0.8 gm.
523	1894	Smirnov	Student	24	62.6	70 gm. butter, 800 gm. bread, 800 cc. milk, 300 gm. meat, 80 gm. sugar, 1,410 cc. tea, 20 gm. blackberries (2 days).	6	27.3	22.8	2.9	+1.6	Daily food, consumed in three portions: At 9 a. m. and 8 p. m., 200 gm. bread, 150 cc. milk, 40 gm. butter; at 1.30 p. m., 400 gm. bread, 500 cc. milk, 40 gm. butter, 300 gm. meat.
524	1894	....do	....do	24	......	....do	6	30.5	23.7	2.3	+4.5	Daily food, consumed in five portions: At 9 a. m., 160 gm. bread, 160 cc. milk, 14 gm. butter; at 12 m., 3, 6, and 9 p. m., 160 gm. bread, 160 cc. milk, 14 gm. butter, 75 gm. meat.
525	1894	....do	Student	25	63.3	Food same as No. 523, with 2,250 cc. tea	6	27.3	26.0	2.7	—1.4	Same as No. 523.
526	1894	....do	....do	25	......	....do	6	30.5	25.6	2.3	+2.6	Same as No. 524.
527	1894	....do	Student	23	68.1	Food same as No. 523, with 1,919 cc. tea	6	31.2	24.9	3.2	+3.1	Same as No. 523.
528	1894	....do	....do	23	......	....do	6	29.5	22.7	1.5	+5.3	Same as No. 524.
529	1894	....do	Student	24	61	Food same as No. 523, with 1,878 cc. tea	6	31.2	24.9	2.8	+3.5	Same as No. 523.
530	1894	....do	....do	24	......	Food same as No. 523, with 2,083 cc. tea	6	29.5	23.1	2.2	+4.2	Same as No. 524.
531	1894	....do	Student	24	71.3	Food same as No. 523, with 2,246 cc. tea	6	28.4	24.1	2.1	+2.2	Same as No. 523.
532	1894	....do	....do	24	......	Food same as No. 523, with 2,207 cc. tea	6	29.7	22.6	2.0	+5.1	Same as No. 524.
533	1894	....do	Student	23	70	Food same as No. 523, with 1,613 cc. tea	6	28.4	24.6	3.9	—0.1	Same as No. 523.
534	1894	....do	....do	23	......	Food same as No. 523, with 2,450 cc. tea	6	29.7	23.7	2.8	+3.2	Same as No. 524.

TABLE 7.—*Miscellaneous experiments on the influence of diet*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
535	1884	Smirnov	Student	24	60.8	Food same as No. 523, with 2,532 cc. tea	6	28.2	20.4	3.0	+4.8	Same as No. 523.
536	1894	.....do	.....do	24	....	Food same as No. 523, with 2,450 cc. tea	6	28.4	20.4	2.7	+5.3	Same as No. 524.
537	1894	.....do	Student	24	69.8	Food same as No. 523, with 2,205 cc. tea	6	28.2	23.5	2.6	+2.1	Same as No. 523.
538	1894	.....do	.....do	24	....	Same as No. 523	6	28.4	21.8	2.4	+4.2	Same as No. 524.

No. 398. Pflüger's Arch. Physiol., 1862, p. 351. Nos. 399, 400. Ibid., p. 322. No. 401. Ibid., p. 318. Nos. 402, 403. Ibid., p. 329. No. 404. Ibid., p. 319. Nos 405, 406. Ibid., pp. 349, 351. No. 407. Ztschr. gesam. Naturw., 31, p. 466. No. 408. Ibid., p. 470. No. 409. Ibid., p. 474. No. 410. Untersuchung der Kost, p. 210. No. 411. Ibid., p. 156. No. 412. Ibid., p. 168. Nos. 413–417. Ztschr. Biol., 15, pp. 170, 173, 175, 176, 198. Nos. 418–420. Ztschr. Biol., 20, p. 386. Nos. 421–423. Influence of various kinds of food upon quantitative and qualitative metabolism of nitrogen in man. Inaug. Diss. (Russian), St. Petersburg, 1887, Table 1. Nos. 424–426. Ibid., Table 2. Nos. 427–429. Ibid., Table 3. Nos. 430–432. Ibid., Table 4. Nos. 433–436. Ibid., Table 5. Nos. 437–440. Ibid., Table 6. Nos. 441–444. Ibid., Table 7. Nos. 445, 446. Vrach, 9, p. 899. Nos. 447, 448. Ztschr. Biol., 24, p. 378. Nos. 449–451. Ibid., 25, p. 114. No. 452. Ibid., 27, p. 463. No. 453. Ibid., p. 465. No. 454. Ibid., p. 467. No. 455. Ibid., p. 469. No. 456. Nordiskt Med. Arkiv., 22, No. 17, p. 9. No. 457. Ibid., p. 15. No. 458. Ibid., p. 19. Nos. 459–461. Ann. Chim. e Farm., 18, 1893, p. 222. Nos. 462–464. Ztschr. Biol., 29, p. 410. Nos. 465–467. Ibid., p. 417. Nos. 468–472. Ibid., p. 425. No. 473. Ibid., p. 229. Nos. 474–480. Jahrb. Thier. Chem., 1892, p. 769. Nos. 481, 482. Ibid., p. 473. Nos. 483–492. Vrach, 13, pp. 599, 600. Nos. 493, 494. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 2, p. 17. Nos. 495–498. Ibid., p. 20. Nos. 499–507. Arch. Hyg., 17, p. 585. Nos. 508–511. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 2, p. 70. No. 512. Ibid., p. 74. No. 513. Ibid, p. 97. No. 514. Ibid., p. 103. Nos. 515–517. Pflüger's Arch. Physiol., 56, p. 227. Nos. 518–520. Ibid, p. 236. Nos. 521, 522. Prager. Med. Wochenschr., 1894, p. 381. Nos. 523, 524. Influence of fractional nutrition on the assimilation and metabolism of nitrogen by healthy individuals. Inaug. Diss. (Russian), St. Petersburg, 1894, pp. 40, Table 1. Nos. 525, 526. Ibid., p. 42, Table 2. Nos. 527, 528. Ibid., p. 44, Table 3. Nos. 529, 530. Ibid., p. 46, Table 4. Nos. 531, 532. Ibid., p. 48, Table 5. Nos. 533, 534. Ibid., p. 50, Table 6. Nos. 535, 536. Ibid., p. 52, Table 7. Nos. 537, 538. Ibid., p. 54, Table 8.

Nos. 398–406. See Nos. 2250–2255, Table 26.

Nos. 407–409 were made by Siewert in 1867 (?). The object was to test the correctness of Voit's theory that all nitrogen is excreted in the urine and feces. Three experiments are described. The author himself was the subject. His food consisted of bread, meat, potatoes, etc. In the first experiment beef was used and in the other two horse meat. The reason for this change was that horse meat had been thought by some to be less digestible than beef. In the author's opinion this was not the case. The meat consumed was both roasted and boiled. In all the experiments the nitrogen in the food, urine, and feces was determined by the soda-lime method. In the first experiment the calcium oxid, phosphoric acid, and chlorin in the urine were determined. In the second and third tests calcium oxid, phosphoric acid, chlorin, sodium oxid, and potassium oxid in the food, urine, and feces were determined, and also the total ash in the food.

The difference between the amount of nitrogen consumed and the amount excreted in the urine and feces was quite small in the first and second experiments and somewhat larger in the third. In the author's opinion this difference in the first two experiments may be accounted for by experimental errors; and in the third experiment there was a considerable gain in body weight, which would partially account for the discrepancy. He believes that Voit's theory that all nitrogen is excreted in urine and feces is correct.

No. 410 was made by Forster, in Munich, in 1874, in connection with a study of the dietaries of the poor and laboring classes. The subject was an old man, janitor of the Physiological Institute. The food was a mixed diet, selected by the subject in accordance with his usual manner of living. The food and urine were analyzed. The nitrogen in the feces was calculated from the results of other observers.

Nos. 411, 412 were made by Schuster in 1877 (?), in Munich, and form part of an extended investigation of the dietary in two prisons. The subject of No. 411 was a prisoner in a house of correction who was compelled to work. The subject of No. 412 was a prisoner in a house of detention and did no work. The food was a mixed diet consisting of soup, bread, vegetables, and a little meat. Somewhat more meat was consumed at the house of detention than at the house of correction. In both prisons the food was divided into portions before each meal and a portion served to each prisoner. Each day of the experiment Schuster selected one of these portions, which was taken to the laboratory in closed jars, weighed, and analyzed. In each experiment one prisoner was selected as a fair representative and his urine and feces were collected and analyzed. As the diet was almost unvarying from week to week, it is presumable that the author's figures give a fair average. The large amount of nitrogen in the feces in No. 411 is very noticeable. It was, of course, due to the fact that the food was largely vegetable. With such a diet there is always a large amount of feces produced, and as the nitrogen in vegetable food is not in a very available form the loss through the feces may be quite considerable.

Nos. 413–417 were made by Rubner, in Munich, in 1877–1879, and form a series with Nos. 127–148, Table 3. The object of the experiment was to observe the quantity of fat which could be digested. The subject of Nos. 413–416 was a laboratory servant. The fat was given in a practically constant mixed diet consisting of bread and meat. Whether analyses of the food were made or whether its composition was calculated from known figures is not stated. The feces were analyzed. The separation was made by means of a milk diet. The amount of fat consumed and excreted in the feces in each test is shown in the following table:

Comparative digestion of fat when taken in different quantities.

No.	Kind of fat eaten.	Fat in food.	Ether extract in feces.	Ether extract in feces.
		Grams.	*Grams.*	*Per cent.*
413	Bacon (95.6 per cent fat)	100	17.2	17.4
414	....do	200	15.2	7.8
415	Butter	240	5.8	2.7
416	Bacon (95.6 per cent fat)	145.8	44.6	12 7
	Butter	233		

It will be seen that when a large quantity of fat was consumed the excreted quantity was large. It is also noticeable that butter was more digestible than bacon. Rubner remarks that this is very likely due, in part, to the fact that butter is more thoroughly acted upon by the digestive juices, since it is in a finely divided condition. The feces contained small pieces of bacon which had evidently not been disintegrated, and were unchanged. The fat in the bacon is also inclosed in fat cells and hence less easily attacked.

The object of No. 417 was to investigate the digestibility of a diet containing practically no nitrogen. The food consisted of starch, fat, sugar, and a little salt. These ingredients were made into a sort of cake. The urine and feces were analyzed.

Nos. 418–420 were made by Rieder in the laboratory of the Physiological Institute at Munich in 1884 (?). The object was to investigate what part of the nitrogen of the feces is due to metabolic products.

The feces consist of undigested residues of food, mucus from the walls of the intestines, coloring matter, salts of fatty acids, bile, and various other products of a similar nature. It is evidently a false assumption that all the nitrogen of the feces comes from unmetabolized matter. That which comes from bile, etc., has been metabolized and formed a part of the nitrogen of the system. In a way, it might be considered as nitrogen which was accidentally lost. This nitrogen is a constant factor in the feces. If no food is consumed the bile is still secreted and, in part, excreted in the feces together with coloring matter, etc. A determination of this nitrogen would apparently show the amount due to metabolic products. Experiments Nos. 558–564, Table 8, are of this character. It does not follow, however, that the secretion of bile, etc., is normal when no food is consumed. Voit made some experiments with a dog having a fistula and found that three times as much (dry) bile was secreted when an abundance of meat was consumed as was the case when no food was eaten.[1]

Almost no work along these lines had been carried on with man. Rieder's experiments were therefore undertaken. The subject was a healthy man of medium weight. The diet contained practically no nitrogen, yet it was sufficient in quantity to insure a normal secretion of digestive juices. It was assumed that under these conditions the nitrogen in the feces would be all due to metabolic products. The food used was a very palatable cake made of starch, sugar, fat, salt, and a leavening powder (cream of tartar and bicarbonate of soda). A little white wine and water were used as beverages. The wine contained a little nitrogen, but so little that it was left out of account. The average amount of nitrogen in the feces was not far from one-half gram per day. The conclusion is reached that this fairly represents the amount of nitrogen due to metabolic products.

Nos. 421–444 were made by Baftalovski in St. Petersburg in 1887. The object was to investigate the influence of various kinds of food on the qualitative and quantitative metabolism[2] of nitrogen in man. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method; the uric acid by Ludwig's method, and the urea by the Borodin method, first removing the extractives by precipitation with phospho-molybdic acid.

Seven experiments are described, four of which (Nos. 421–432) consisted of three periods, the first with an animal diet, the second with a mixed diet, and the third

[1] Ztschr. Biol., 20, p. 380.

[2] The Russians use the terms which have been translated assimilation and metabolism in the following definite sense: Assimilated nitrogen means digested nitrogen. Metabolism of nitrogen means the ratio of nitrogen of urine to assimilated nitrogen. The qualitative metabolism of nitrogen means the ratio of partially oxidized nitrogen in urine to nitrogen of urea. The normal value of this ratio for man is assumed to be 1:14. Metabolism is qualitatively increased if this ratio is less than normal and decreased if it is greater than normal.

with a varied vegetable diet. Three experiments (Nos. 433–444) were divided into four periods, the first with a mixed diet, the second and third with an unvaried vegetable diet (thin and thick millet gruel), and the fourth with a mixed diet. Four of the experiments were made by the author and 3 by a physician, Kurcheninov, with the author's assistance. The subjects were the author, another physician, 3 medical students, and 2 hospital servants. All were in normal health. The students attended lectures during all the time of the experiment. The author worked in the laboratory frequently until 4 or 5 o'clock in the morning. The other physician performed very little muscular work, but did considerable mental work. During the last 2 days on vegetable diet he worked in the laboratory.

The author sums up his results as follows: The total nitrogen of urine, nitrogen of urea, nitrogen of extractives, and uric acid was greatest on the animal diet and least on the vegetable diet. When a varied vegetable diet was consumed, half as much nitrogen was excreted in the urine as when animal food was consumed, and one-fourth as much as when on a mixed diet. When millet gruel only was consumed, about one-third as much nitrogen was excreted in the urine as when a mixed diet was consumed. On an animal diet the ratio of nitrogen of urea to nitrogen of extractives was less than on a varied vegetable diet and greater than on a mixed diet. On a mixed diet the ratio of urea to nitrogen of extractives and the ratio of uric acid to urea (comparing both the weight and nitrogen content) was less than on a diet of animal or vegetable food. Considerable less nitrogen of urea and of extractives was excreted on a varied vegetable diet and on a millet meal diet than on a mixed or animal diet. The total solids in the urine were nearly the same on a mixed diet and on an animal diet and greatest when vegetable food was consumed. The metabolism and assimilation of nitrogen were most complete on an animal diet and least complete on a vegetable diet. On a varied vegetable diet the organism maintained nitrogen equilibrium unless too much work was performed. With an unvaried vegetable diet metabolism increased about 300 per cent over normal, and a protein famine resulted. More liquid was consumed on a diet of animal food than on a mixed or vegetable diet. The greatest quantity of urine was excreted on a vegetable diet and the least on a mixed diet. When animal and unvaried vegetable food was consumed, the weight of the body decreased and increased on a mixed and a varied vegetable diet. The subjects felt well on a mixed and a varied vegetable diet. This was not the case on a diet of animal food or on an unvaried vegetable diet.

Nos. 445, 446 were made by Levin in St. Petersburg in 1888 in connection with a study of corpulence. Two experiments are described, each of 12 days' duration. The food consisted of an abundant mixed diet of bread, meat, cheese, etc. The subject of the first experiment began to grow fat after he was 30 years old. He led a sedentary life, and food rich in carbohydrates was apparently the cause of corpulence. The subject of the second experiment inherited his tendency to corpulence. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author sums up his results as follows: In the first experiment there was a striking relative as well as absolute decrease of the metabolism of nitrogen, and in the second experiment there was a marked absolute decrease. This difference in metabolism is thought to be due to the difference in age and degree of obesity.

Since obesity represents not only an anomaly of nourishment, but also an anomaly of metabolism (at least of nitrogen), its treatment by exercise alone would be unwarranted. Metabolism may be influenced by diet, hot baths, cold baths, douches with friction, massage, alkaline mineral waters, etc.

These experiments might have been included in Table 18, since excessive corpulence is regarded as a constitutional disease.

Nos. 447, 448. See Nos. 4–7, Table 1.

Nos. 449–451 were made by Mori in the Physiological Institute of the University of Tokyo in 1888 in connection with a study of the dietary of the Japanese,

According to the author, 3 general classes of dietaries are common among the Japanese, viz, (1) that of the rural population of the interior, an almost exclusively vegetable diet, as fish is eaten but once or twice a month and meat but once or twice a year; (2) that of the population of the coast, who eat fish in considerable quantities; and (3) that of the city population and of well-to-do families, who eat both meat and fish to a considerable extent.

Rice is the principal article of vegetable food, but in addition to this barley, wheat, various kinds of millet, and buckwheat are eaten in considerable quantities. Tubers and roots, such as turnips and radishes, are staple articles of food, and pumpkins, cucumbers, etc., are much used. The legumes are little eaten in their natural state, but form the basis of a number of prepared foods and relishes, such as miso, tofu, and shoyu, all of which are made from the soy bean. Miso is prepared from cooked beans, which are rubbed to a thick paste and fermented with the ferment used in the preparation of the rice wine. Tofu, or bean cheese, is essentially the legumin of the soy bean, which is first extracted with water and then precipitated by the addition of the mother liquor (magnesium chlorid), obtained from the evaporation of sea water in the manufacture of salt. The cheese is eaten fresh. The shoyu sauce is prepared from a mixture of cooked and pulverized soy beans, roasted and pulverized wheat, wheat flour, salt, and water. The mixture is fermented with the above-mentioned rice ferment for 1½ to 5 years in casks. This sauce is used very largely by all classes.

The author was himself the subject of these experiments, which cover the three kinds of diet usual in Japan.

The food, urine, and feces were analyzed.

Nos. 452–455 were made by Lusk in the laboratory of the Physiological Institute in Munich in 1890. The object was to investigate the influence of carbohydrates on the metabolism of protein. It was of interest to study this question because Voit was of the opinion that in cases of diabetes the large amount of protein metabolized was due to the fact that sugar was no longer a nutrient. It was also possible that the large amount of protein and fat metabolized was due to some deep-seated change in the tissues and cells of the organism. The investigator, who was in good health, was himself the subject.

The food (with the exception of the meat), urine, and feces were analyzed. The nitrogen content of the meat was calculated from Voit's value, 3.4 per cent. The bread (Zwieback) was made from wheat flour and yeast. The gluten bread was made from wheat gluten and yeast and contained no starch.

In No. 452, with an abundance of protein, fat, and carbohydrates, the organism gained a little nitrogen. In No. 453 there was the same amount of nitrogen in the diet, but no carbohydrates. The organism lost considerable nitrogen. In No. 452 the carbohydrates therefore served as a protector of protein. In Nos. 454 and 455 the amount of protein consumed was small, being about the amount consumed from the tissues of the organism when fasting. In No. 455, also, where no carbohydrates were consumed, much more nitrogen than the normal amount was excreted.

The article contains much theoretical discussion of metabolism in diabetes, and the conclusion is reached that the variations from normal metabolism in such cases are really due to the failure of the organism to assimilate carbohydrates.

Nos. 456–458 were made by Hultgren and Landergren at Stockholm in 1890. The object was to investigate the digestibility of a mixed diet. Three experiments are described. The subject of the first two was a sailor 32 years old, and the subject of the last a workingman 19 years old.

In No. 456 the diet was that usually furnished to sailors on land, and in No. 457 the usual diet for sailors on board ship was consumed. In No. 458 the food was similar to that in No. 457, though simpler. The bread eaten in the first and third experiments was made from coarse rye flour and in the second from bolted rye flour. The bran in the bread was analyzed and found to contain 3.67 per cent nitrogen, 74.8 per cent nitrogen-free extract, and 2.3 per cent ash. The nitrogen in the food, urine, and

feces was determined. The subject of No. 458 vomited on the second day, and the matter thus excreted is taken into account in the figures given in the table.

The authors state that the method of preparation of the food has a greater effect upon the assimilation of vegetable protein than upon animal protein. The bran in coarse bread is not readily assimilated by man. In No. 457, where fine rye bread was consumed, the assimilation of protein and carbohydrates was most complete.

In the first experiment 13.2 per cent, in the second 8.6 per cent, and in the third 13.4 per cent of the potential energy of the food was lost in the feces. The difference in these figures is thought by the authors to be due to the difference in bran content of the bread. Rubner has found that on a mixed diet containing rye bread the total energy of the food lost in the feces amounted to 15 per cent.

The authors consider further investigations necessary before drawing general conclusions.

Nos. 459–461 were made by Buys in 1892. The object was to study the metabolism of a man who habitually consumed very small quantities of nitrogen. The subject was a factory operative, 60 years old. He worked in a factory 10 or 12 hours daily and took considerable exercise in addition. Since his twentieth year he had been accustomed to eat only small quantities of bread, butter, and vegetables. During the experiment his diet consisted of bread and other vegetable food, with a little meat or eggs. König and von Noorden's figures were used in computing the analyses of all the food consumed except the beer, which was analyzed. The nitrogen in the urine was determined. The nitrogen in the feces was taken by the compilers from Pechsel's experiments, Nos. 376–378, Table 6, in which the food was somewhat similar. The amount of consumed nitrogen was about the same, though in Pechsel's experiment no meat was eaten. A little meat extract, however, was taken.

The diet contained only 7 or 8 grams of nitrogen, yet the subject was apparently in good physical condition. The nitrogen-free constituents were not abundant enough to make up the deficiency in nitrogen, since the fuel value of the diet was only 1,600 calories.

Nos. 462–473 form a series with Nos. 49–53, Table 2. They were made by Camerer at Riedlingen and Urach, in Würtemberg, in connection with dietary studies extending from 1878 to 1892. They are by far the most extended and important investigations of the dietaries of children which have been made.

In Nos. 49–53, Table 2, the food was milk, with a little water or coffee. In Nos. 462–473 it consisted of a mixed diet.

Camerer made all told seven series of dietaries of his own children, 4 girls and 1 boy, from 1878 to 1892. In 1878 the ages of the girls were 2, 3½, 9, and 11 years, and that of the boy 5½ years.

The general plan of these investigations consisted in observing the food of each child for six periods (in a few cases a less number) of 4 days each during each year. The six dietaries thus obtained were averaged together for the dietary of the child for the year.

Except in one of the seven annual series weighings were made of the food actually eaten and its composition in part determined by analysis and in part estimated from König's compilations. In addition to these data the weights of the children were observed from day to day, the urine was collected and the urea determined, and the feces collected, weighed, and analyzed.

During the period between 1878 and 1892, 31 of these average annual dietaries were made, representing approximately 37 observations for each child, or 186 for the five children. It should be added that the children were healthy and their growth was normal, although the girls who had attained the ages of 15 to 20 before the end of the study were somewhat smaller than the average.

These dietaries have been quoted at length in a previous publication of this Office.[1]

Nos. 474–480 were made by Oi in the laboratory of the Japanese Imperial Military

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 192.

Medical Institute in Tokyo in 1892. The object was to determine the relative value of rice alone and a mixture of rice and barley. The subjects were men, presumably soldiers. The diet consisted of rice or rice and barley, with some meat, fish, vegetables, or tofu (bean cheese). For many hundred years rice, with some fish or other nitrogenous food, has been the principal article of diet in Japan. An attempt has been made by many to substitute barley, which is richer in protein, for a part of the rice. This question has for some time excited the interest of all thinking people in Japan, and each party has made many investigations, and much for and against the new idea has been said and written.

The original report of Oi's investigation was not available, and few details can be given. The author's conclusion is that the nitrogen is much better assimilated in the rice diet than in the rice and barley diet.

Nos. 481, 482 were made by Oi in 1892 at the same place as the preceding experiments. The object of the investigation was to compare the value of the European and Japanese diets. The subjects in each experiment were 10 nurses. In No. 481 the European diet, consisting chiefly of meat and bread, was followed, and in No. 482 the Japanese diet of rice and fish.

The original publication was not available, and few details are given in the journal cited.

Nos. 483–492 were made by Guriev in St. Petersburg in 1892. The object was to investigate the normal amount of protein required by old men and to study the metabolism of nitrogen. The subjects were from 65 to 88 years of age. The two oldest were rather decrepit. The other three were hale and hearty. Each experiment was divided into two periods. In the first period the metabolism and assimilation of nitrogen was especially studied. The food consisted of a mixed diet and furnished daily 90 grams protein, 42 grams fat, 372 grams carbohydrates, and 2,286 calories of energy. In the second period the amount of protein was diminished, while the fat and carbohydrates were correspondingly increased. The diet during this period furnished 55 grams protein, 87 grams fat, 385 grams carbohydrates, and 2,615 calories.

The subjects were weighed morning and evening. The nitrogen in the food, urine, and feces was determined by the Kjeldahl method, with later modifications. The results of these experiments were compared with those of Jawein with healthy young men (see Nos. 820–850, Table 9).

The following conclusions were reached: The average assimilation of nitrogen in the first period was 91.15 per cent, and in the second period 86.17 per cent. According to Jawein, the assimilation of nitrogen in healthy young men on a similar diet is 94 per cent. In the first period the metabolism was less than normal; in the second period it was somewhat greater than in the first period. In the first period the ratio of partially oxidized products in the urine to urea was greater than normal, i. e., the metabolism of the subjects was quantitatively inferior to that of young men. This ratio decreased somewhat during the second period. When the diet contained a smaller amount of protein, but an abundance of fat, the subjects maintained their usual weight and health.

The general conclusion was reached that the amount of protein ordinarily consumed by aged men may be diminished if an abundance of carbohydrates and fat is supplied in its place.

Nos. 493–498 were made by Kayser at the medical department of the University of Berlin in 1892. The object was to investigate the relation of fat and carbohydrates to the metabolism of protein. The subject was the investigator himself. He was 23 years old, tall and thin. The experiment lasted 10 days and was divided into three periods.

The food consisted of meat, cakes, rice, sugar, butter, oil, and green salad (lettuce?). The beverages consumed were tea and water. In the first and third periods the diet contained protein, fat, and carbohydrates; in the second period, protein and fat.

The nitrogen in the meat, rice, and cakes and in the urine and feces was determined, and also the fat in the meat, butter, and cakes and in the feces; the carbohydrates in the rice and cake, and the sodium chlorid and phosphoric acid in the urine. The meat consumed was very lean. Other details of food composition were calculated. The green salad was left out of account. The separation of the feces was made with charcoal. In the second period, though the total energy of the diet was comparatively large, there was a considerable loss of nitrogen.

The following conclusions were reached: Fat is as well fitted to protect protein as is an isodynamical quantity of carbohydrates. A very large consumption of protein and fat alone would be necessary in order to maintain nitrogen equilibrium. It is doubtful if the organism could gain nitrogen on such a diet. The period in the above experiments was short. It is possible that in long periods the organism could adjust itself to a diet containing only fat and protein.

The above considerations refer to healthy individuals. In cases of diabetes the conclusions are somewhat different.

Nos. 499–507 were made by Manfredi in the laboratory of the Hygienic Institute in Naples in 1892, and have been described at length in a previous publication.[1] The object of the investigation, of which these experiments form a part, was a study of the dietary and conditions of living of the very poor people. The subjects were street venders, day laborers, and beggars. The food consisted of macaroni in various forms, soup, vegetables, etc., and a little meat. The food, urine, and feces were analyzed.

Nos. 508–512 were made by Dapper in the department of medicine of the University of Berlin in 1892–93. The object was to investigate metabolism during a course of treatment for corpulency. Several treatments have been proposed. The methods vary, but the plan is usually to cause a large loss of fat, but at the same time a very small loss of protein. The investigator himself was the subject. He was 1.68 meters tall, and weighed, when the first experiment began, about 100 kilograms. His muscles were well developed, and he was also quite fat. He had endeavored to keep from gaining fat for some time by consuming a rather limited diet containing little fat and an abundance of meat and other animal food, by consuming very little alcoholic beverages, and by taking considerable exercise.

The diet followed in the experiment consisted of meat, eggs, caviar, cakes, bread, etc. The food was usually analyzed, and the nitrogen in the urine and feces and the fat in the feces determined. The analyses were made under the direction of von Noorden.

During the whole time the subject performed his regular laboratory work and took considerable exercise. In every case the total energy of the food was small—about 1,500 to 1,600 calories. The protein, however, was abundant, the supposition being that the organism would consume enough of its own fat to make up the required energy.

In the first 8 days of the first test (No. 509) the daily loss in weight was 0.411 kilogram, in the last 12 days (No. 510) the daily loss was 0.225 kilogram, in No. 511 it was 0.342 kilogram, and in No. 512, 0.317 kilogram. In Nos. 509 and 512 there was a small loss of nitrogen, showing that a little flesh was also lost. In other cases there was a gain of flesh. The loss of weight was caused not by a loss of fat alone, but of fat and water.

The author concludes that it is possible to obtain the desired end in experiments of this nature, i. e., cause a large loss of fat, and at the same time protect the protein of the organism.

It is essential that the nitrogen excretion be frequently investigated in order to be sure that the organism is not losing protein.

In the above investigation the respiratory quotient of the subject was determined by Zuntz.

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 173.

The article contains much matter relating to cures for corpulency, which is interesting from a medical standpoint.

Nos. 513, 514 were made by Krug in the medical department of the University of Berlin in 1892. The object was to determine whether it was possible to so regulate the diet that there should be a gain in muscular tissue under ordinary conditions. Such a gain is of course the rule under the following conditions: Growth, conception, and lactation, and always when an organism which has had no food or an insufficient diet or has been weakened by sickness or exhausted by excessive work is again supplied with an abundant diet.

If the supply of fat is greater than is required, fat is stored up as a reserve material. In the same way an excess of carbohydrates is converted into fat and stored up. It is not so clear, however, what becomes of an excess of protein. The theory is advanced that when much protein is supplied the excess over the amount necessary may be utilized in two ways, (1) as "reserve protein," i. e., protein which is stored up in the cells of the tissues in the same way as fat, or (2) as "acquired" protein, i. e., protein which has been transformed into an essential part of the tissues and forms new cells. Experiments with animals have shown that it is possible to store up or gain protein when the supply is large and other nutrients are very abundant. It was desirable to investigate the same problem with a healthy man.

The author was himself the subject of his experiments. The food consisted of cocoa, meat, sausage, eggs, bread, fruit, etc. The food, urine, and feces were analyzed.

No. 513 was a preliminary experiment. With the diet supplied the organism was practically in nitrogen equilibrium.

In No. 514 the protein remained about the same, but the amount of fat and carbohydrates was very much increased. There was a daily gain of 3.4 grams of nitrogen, or a total gain of 51 grams. The subject gained 3.1 kilograms in weight. Taking into account the gain in flesh, the gain in fat (shown by the excess of fat consumed over that excreted in the feces), and the increase in weight, the following figures are given:

	Grams.
Gain in weight	3,100
Gain in flesh	1,455
Gain in fat	2,254
Loss of water	609

The experiments agree with those made with animals; that is, protein can be gained in considerable quantity, but, as the author says, there is no proof that it is in the form of "acquired" protein. The gain was so large that it is impossible to consider it "circulating protein," which was Voit's idea of protein stored up under similar circumstances. It is very probable that, in accord with von Noorden's theory, the protein gained is stored up as "reserve" material.

Nos. 515–520 were made by Albertoni and Novi at the University of Bologna in 1892, and form part of an extended dietary study of Italian peasants. The subjects were a peasant living in the neighborhood of Farrara, his wife, and son. The people were in good health, but very poor. Their combined yearly earnings amounted to only $97, of which $81 was expended for food. Their food in winter was mainly maize and chestnut meal, macaroni, beans, fish, and lard. In summer the maize meal was in part replaced by bread. The food was accurately weighed and analyzed, as were also the urine and feces. The experiments represent two periods of observation of 3 days each, one in March and the other in August.

Nos. 521, 522 were made by von Limbeck in Vienna in 1894, and are briefly reported. The object was to investigate the metabolism of calcium oxid. The subjects were two aged women. The diet was mixed, but the food was not specified, nor is it stated that analyses were made. It is probable that the calcium oxid in the urine and feces was determined. The author concludes that the experiments were made at a time when the organism for some reason was under abnormal conditions as regards

calcium oxid metabolism ("senile osteosporosis"), or that the diet selected did not supply enough calcium oxid for the needs of the organism. At any rate the subjects lost considerable calcium oxid each day. It is not possible that such a loss could continue for a long time without fatal results. The calcium oxid was almost entirely excreted in the feces.

Nos. 523–538 were made by Smirnov at Tshudnovsky's laboratory in St. Petersburg in 1884. The object was to study the effect upon the assimilation and metabolism of nitrogen of consuming the daily food at frequent intervals. The term fractional nutrition has been applied to such a division of the daily ration. The subjects were 8 healthy young men. The experiments were of 12 days' duration and each was divided into 2 equal periods. The same quantities of bread, milk, butter, and meat were consumed daily. Weak tea with a little sugar was taken as a beverage.

During the first period the subjects consumed the food under normal conditions, i. e., in 3 portions daily. Three-fifths of the total nitrogen of the food was furnished by the midday meal and one-fifth by each of the other meals. During the second period the food was consumed in 5 portions daily.

The separation of the feces was made with blackberries. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The principal conclusions reached were the following: When the food was consumed in 5 portions the assimilation of nitrogen increased on an average 2.39 per cent; the quantitative metabolism of nitrogen decreased on an average 8.37 per cent; and, judging by the amount of extractives in the urine, the qualitative metabolism of nitrogen increased on an average 1.54 per cent. The subjects gained in weight.

In addition the author studied the effect of fractional nutrition on the action of putrefactive bacteria in the intestines. As an index of bacterial action the ratio of preformed sulphuric acid to ether sulphuric acid in the urine was determined. The preformed sulphuric acid was determined by Salkowski's method and the ether sulphuric acid by Baumann's method. The ratio of one to the other was not affected by fractional nutrition.

Since the data for this bulletin were compiled a few experiments with man which would properly be included in this section have been published by American investigators. Atwater[1] has reported an experiment made by Slagle, Smith, and Torrey. They themselves were the subjects. They were all healthy young men weighing from 60 to 68 kilograms. The test lasted 10 days. A simple mixed diet was consumed. Most of the foods were analyzed, as were also the urine and feces. The heats of combustion of the food, urine, and feces were determined with a bomb calorimeter. The daily diet furnished 115.8 grams of protein, 164.8 grams of fat, 535.6 grams of carbohydrates, and 4,428 calories. The income and outgo of nitrogen per man per day was as follows: In food 18.4 grams, in urine 11.9 grams, in feces 1.7 grams; gain 4.8 grams.

From a large number of digestion experiments with man, Atwater has deduced[2] the following average coefficients of digestibility of the different nutrients:

Calculated coefficients of digestibility.

	Protein.	Fat.	Carbohydrates.
	Per cent.	*Per cent.*	*Per cent.*
Animal foods	98	97	100
Cereals and sugars	85	90	98
Vegetables and fruits	80	90	95

In a considerable number of experiments, including the above, the calculated digestibility, using these coefficients, was found to agree very closely with that

[1] Connecticut Storrs Sta. Rpt. 1896, p. 163.

[2] Ibid., p. 186.

actually obtained. It would appear, therefore, that in determining the actual food value of various articles of diet these calculated coefficients of digestibility may be used similarly to the coefficients of digestibility which are employed in determining the value of feeding stuffs.

Snyder[1] has reported an experiment on the digestibility of potatoes when consumed with milk, cream, and eggs. The subject was a healthy young man weighing about 63 kilograms. The daily diet consisted of 1,587.6 grams of potatoes, 710 cubic centimeters of milk, 237 cubic centimeters of cream, and 8 eggs, and furnished 113.3 grams of protein, 102.4 grams of fat, 319 grams of carbohydrates, and 2,883 calories. The experiment covered 4½ days. The daily income and outgo of nitrogen was as follows: In food, 18.1 grams; in urine, 15.7 grams; in feces, 2.0 grams; gain, 0.4 gram.

Taking into account the digestibility of cooked eggs, as determined by the Stutzer method, the author calculated the digestibility of potatoes alone.

A number of other experiments in which the balance of income and outgo was determined have been made under the direction of this Department, but are not yet published.

Hoover and Sollmann[2] studied the metabolism of a fasting man during hypnotic sleep. The subject was a healthy young man and remained in hypnotic sleep for 9 days, awakening only once during this period. He was supplied with water but consumed no food. The urine was collected with a catheter and analyzed but no feces were produced. During the whole period the subject excreted 113.6 grams nitrogen or 12.4 grams per day. As the experiment progressed, the loss of phosphoric acid became greater in proportion to the amount of nitrogen. The uric acid excreted diminished on the first day but increased on the succeeding days.

"The chlorids gradually decreased in amount, reaching the minimum on the last day. The total loss of the body weight was 5,896 grams, 3,341 of which must have been proteid material, as estimated in lean muscle from the amount of nitrogen lost. Assuming that the maximum amount of glycogen in the liver was 200 grams, which we may assume was all consumed, the loss in fat and water would be 2,355 grams."

The authors compare their results with those obtained in experiments with fasting men and discuss the subject from a medical standpoint.

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 43, p. 20.
[2] Jour. Exptl. Med., 2 (1897), p. 405.

HEALTHY SUBJECTS, INFLUENCE OF OTHER CONDITIONS THAN DIET.

A comparatively large number of experiments have been made with man in which the effects of other conditions than diet upon the balance of income and outgo of nitrogen were studied. Some of these conditions were more or less abnormal. Experiments of the latter kind often serve a twofold purpose. They throw light upon the influence upon metabolism of the special point under consideration, for instance, the effect of fasting or of different drugs; and by comparison it is often possible to draw conclusions concerning the normal or usual conditions. For example, experiments with fasting man have shown the effect of consuming no food upon the excretion of nitrogen and upon other special questions. They have also shown, in the opinion of many investigators, the smallest amount of protein upon which the organism can maintain itself, since it was believed that when living upon its own tissues the organism would utilize its resources in the most economical way possible.

Some of the special questions studied are of great interest and importance in themselves. The influence of muscular exertion upon the excretion of nitrogen may be cited. This involves the question of the source of muscular energy. The exact service rendered by the nitrogenous and nonnitrogenous nutrients as sources of energy in the animal body is not yet clearly understood. Closely connected with the experiments on the effect of muscular energy are those in which massage was employed, since this may perhaps be regarded as equivalent to involuntary muscular exertion.

The study of the changes in metabolism due to various phases of sexual life is of great importance, yet the investigations made on these lines are not as numerous as might be expected.

In the section of this compilation devoted to experiments with animals many investigations are noted which were more or less similar to those mentioned above.

EXPERIMENTS IN WHICH THE SUBJECTS WERE FASTING.

In Table 8 are included 62 tests with men and 4 with women in which the subjects were fasting. Fasting may be either partial or complete. Most of the experiments of the latter kind were made with well-known professional fasters. A number of tests with diseased subjects consuming no food are included in Tables 17 and 24. Experiments with fasting subjects in which the balance of carbon and nitrogen was determined are included in Table 26. Tests with fasting animals are included in Tables 28, 29, 30, 31, 34, and 38.

TABLE 8.—*Experiments in which the subjects were fasting.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
539	1885	Tuczek	Woman	32	65	175 cc. water	7	0.0	4.3	0.0	— 4.3	Eighth to fifteenth day of fasting.
540	1885	....do	....do	32	....	Soup, bread, meat, etc	6	21.9	8.3	9.7	+ 3.9	
541	1885	....do	Woman	38	54	A very little bouillon, beer, orange, and water.	16	2.4	4.3	0.2	— 2.1	
542	1885	....do	....do	38	....	Beer, white bread, bouillon, egg, sausage, ham, orange, water, etc.	8	12.0	8.1	8.8	— 4.9	
543	1887	Sadovyen	Man	28	79.5	1,044 gm. milk, 476 gm. meat, 432 gm. bread, 67 gm. sugar, 1,398 gm. tea or water.	1	26.2	20.8	3.1	+ 2.3	
544	1887	....do	....do	28	78.8	Fasting	2	0.0	12.1	0.1	—12.2	
545	1887	....do	....do	28	76.2	2,291 gm. milk, 472 gm. meat, 155 gm. bread, 153 gm. sugar, 1,452 gm. tea or water.	1	31.3	14.8	3.1	+13.4	
546	1887	....do	....do	28	80.2	86 gm. bread, 25.5 gm. sugar, 200 gm. tea, 1,529 gm. water.	1	0.9	12.4	0.0	—11.5	Practically fasting.
547	1887	....do	....do	28	77.7	1,833 gm. water	3	0.0	8.3	0.0	— 8.3	
548	1887	....do	....do	28	75.1	566 gm. milk, 679 gm. meat, 433 gm. bread, 125 gm. sugar, 1,192 gm. water.	1	35.0	14.8	0.0	+10.2	
549	1887	....do	....do	28	80.2	— gm. sugar, — gm. starch, — gm. water	1	0.0	10.0	0.1	—10.1	
550	1887	....do	....do	28	79.0	453 gm. sugar, 73 gm. starch, 1,652 gm. water.	1	0.0	5.6	0.1	— 5.7	
551	1887	....do	....do	28	78.2	352 gm. sugar, 115 gm. starch, 1,819 gm. water.	1	0.0	6.4	0.1	— 6.5	
552	1889	Paton and Stockman.	Professional faster	47	62	Fasting	5	0.0	12.0	0.0	—12.0	First to fifth day of fasting.
553	1889	....do	....do	47	....	....do	5	0.0	5.4	0.0	— 5.4	Sixth to tenth day of fasting.
554	1889	....do	....do	47	....	....do	5	0.0	5.1	0.0	— 5.1	Eleventh to fifteenth day of fasting.
555	1889	....do	....do	47	....	....do	5	0.0	4.3	0.0	— 4.3	Sixteenth to twentieth day of fasting.
556	1889	....do	....do	47	....	....do	5	0.0	4.3	0.0	— 4.3	Twenty-first to twenty-sixth day of fasting.
557	1889	....do	....do	47	....	....do	5	0.0	3.4	0.0	— 3.4	Twenty-sixth to thirtieth day of fasting.
558	1889	Klemperer	Insane man	34	64	Fasting. 1-2 glasses of water	3	0.0	4.0	(0.0)	— 4.0	Sixth to eighth day of fasting.
559	1889	Munk	Man	21	59.6	Fasting	6	0.0	11.3		—11.3	

560	1889	.....do	.....do	21	....	Mixed diet (101 gm. protein, 129 gm. fat, 309 gm. carbohydrates).	2	16.2	8.6		+ 7.6	First two days after fasting.
561	1889	Voit	Laboratory servant	....	74	Fasting	1	0.0	7.0	0.0	— 7.0	
562	1889	Luciani	Professional faster (Succi).	....	....	.....do	10	0.0	10.7		—10.7	
563	1893	Lehmann, Müller, Munk, Senator, and Zuntz.	Professional faster (Cetti).	25	57	Fasting. 1,200 gm. water	10	0.0	11.3	0.3	—11.6	
564	1893	.....do	Professional faster (Breithaupt).	21	60	Fasting. 924 gm. water	6	0.0	11.3	0.1	—11.4	
565	1894	Gorokhov	Soldier (Z.)	24	....	800 gm. white bread, 60 gm. sugar, 60 gm. butter, 800 cc. milk, 300 gm. meat, 2,088 cc. tea.	3	30.2	24.8	1.4	— 4.0	
566	1894	.....do	.....do	24	....	60 gm. sugar, 1,253 gm. black bread, 2,784 cc. tea.	3	16.0	18.2	3.4	— 5.6	
567	1894	.....do	.....do	24	....	800 gm. white bread, 800 cc. milk, 300 gm. meat, 60 gm. sugar, 63 gm. butter, 2,088 cc. tea.	3	29.7	24.3	1.2	+ 4.2	
568	1894	.....do	.....do	24	....	1,300 gm. black bread, 60 gm. sugar, 2,784 cc. tea.	3	15.5	18.3	4.2	— 7.0	
569	1894	.....do	.....do	24	....	Same as No. 567	3	31.5	21.6	2.0	+ 7.9	
570	1894	.....do	Soldier (Y.)	24	....	800 gm. white bread, 800 cc. milk, 300 gm. meat, 60 gm. sugar, 60 gm. butter, 2,034 cc. tea.	3	30.2	20.7	2.1	+ 7.4	
571	1894	.....do	.....do	24	....	1,300 gm. black bread, 60 gm. sugar, 2,838 cc. tea.	3	16.6	16.4	3.8	— 3.6	
572	1894	.....do	.....do	24	....	800 gm. white bread, 800 cc. milk, 300 gm. meat, 60 gm. sugar, 63 gm. butter, 2,034 cc. tea.	3	29.7	24.1	2.2	+ 3.4	
573	1894	.....do	.....do	24	....	Same as No. 571	3	15.5	17.0	3.8	— 6.3	
574	1894	.....do	.....do	24	....	Same as No. 572	3	31.5	24.3	2.3	+ 4.9	
575	1894	.....do	.....do	24	....	569 gm. white bread, 1,000 cc. milk, 300 gm. meat, 360 gm. sugar, 60 gm. butter, 1,703 cc. tea.	3	24.1	18.1	1.8	+ 4.2	
576	1894	.....do	.....do	24	....	900 gm. black bread, 60 gm. sugar, 2,250 cc. tea.	3	11.8	15.1	5.8	— 9.1	
577	1894	.....do	.....do	24	....	600 gm. white bread, 300 gm. meat, 60 gm. sugar, 60 gm. butter, 1, 750 cc. tea.	3	26.1	21.2	1.5	+ 3.4	
578	1894	.....do	.....do	24	....	Same as No. 576	3	14.0	16.6	4.0	— 6.6	
579	1894	.....do	.....do	24	....	Same as No. 577	3	25.7	23.9	1.4	+ 0.4	
580	1894	.....do	Soldier (K.)	24	....	800 gm. white bread, 500 cc. milk, 300 gm. meat, 60 gm. sugar, 60 gm. butter, 2,250 cc. tea.	3	26.0	23.8	1.6	+ 0.6	
581	1894	.....do	.....do	24	....	1,100 gm. black bread, 60 gm. sugar, 2,800 cc. tea.	3	14.4	14.9	5.1	— 5.6	
582	1894	.....do	.....do	24	....	Same as No. 580	3	26.7	24.0	1.6	+ 1.1	
583	1894	.....do	.....do	24	....	1,300 gm. black bread, 60 gm. sugar, 2,767 cc. tea.	3	17.1	17.5	4.7	— 5.1	
584	1894	.....do	.....do	24	....	800 gm. white bread, 500 cc. milk, 300 gm. meat, 60 gm. sugar, 60 gm. butter, 2, 500 cc. tea.	3	26.6	22.4	1.6	+ 2.6	

TABLE 8.—*Experiments in which the subjects were fasting*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
585	1894	Gorokhov	Soldier (P.)	24	......	800 gm. white bread, 500 cc. milk, 300 gm. meat, 60 gm. sugar, 60 gm. butter, 2,160 cc. tea.	3	26.0	20.5	1.6	+ 3.9	
586	1894	...do	...do	24	......	1,033 gm. black bread, 60 gm. sugar, 4,640 cc. tea.	3	13.5	13.0	5.2	— 4.7	
587	1894	...do	...do	24	......	Same as No. 585	3	26.7	21.1	1.7	+ 3.9	
588	1894	...do	...do	24	......	1,000 gm. black bread, 60 gm. sugar, 2,640 cc. tea.	3	15.5	15.0	4.2	— 3.7	
589	1894	...do	...do	24	......	Same as No. 585	3	26.6	20.3	1.7	+ 4.6	
590	1894	...do	...do	24	......	800 gm. white bread, 1,000 cc. milk, 300 gm. meat, 60 gm. sugar, 70 gm. butter, 1,500 cc. tea.	3	29.3	23.9	2.3	+ 3.1	
591	1894	...do	...do	24	......	1,200 gm. black bread, 60 gm. sugar, 2,600 cc. tea.	3	18.3	16.7	4.7	— 3.1	
592	1894	...do	...do	24	......	Same as No. 590	3	30.2	25.2	1.5	+ 3.5	
593	1894	...do	...do	24	......	933 gm. black bread, 60 gm. sugar, 1,500 cc. tea.	3	13.7	14.8	4.0	— 5.1	
594	1894	...do	...do	24	......	800 gm. white bread, 1,000 cc. milk, 293 gm. meat, 60 gm. sugar, 70 gm. butter, 1,500 cc. tea.	3	29.8	23.6	1.9	+ 4.3	
595	1894	...do	Soldier (O.)	24	......	800 gm. white bread, 1,000 cc. milk, 300 gm. meat, 60 gm. sugar, 70 gm. butter, 2,250 cc. tea.	3	29.3	25.6	3.1	+ 0.6	
596	1894	...do	...do	24	......	1,200 gm. black bread, 2,500 cc. tea	3	18.3	16.5	5.9	— 4.1	
597	1894	...do	...do	24	......	Same as No. 595	3	30.2	23.6	3.3	+ 3.3	
598	1894	...do	...do	24	......	Same as No. 596	3	17.6	18.0	6.5	— 6.9	
599	1894	...do	...do	24	......	800 gm. white bread, 1,000 cc. milk, 293 gm. meat, 60 gm. sugar, 70 gm. butter, 2,250 cc. tea.	3	29.8	23.7	2.4	+ 3.7	
600	1894	...do	Soldier (K.)	23	......	800 gm. white bread, 1,000 cc. milk, 300 gm. meat, 60 gm. sugar, 70 gm. butter, 2,250 cc. tea.	3	29.3	27.4	3.6	— 1.7	
601	1894	...do	...do	23	......	1,200 gm. black bread, 60 gm. sugar, 2,750 cc. tea.	3	18.3	17.1	6.6	— 5.4	
602	1894	...do	...do	23	......	Same as No. 600	3	30.2	23.2	2.9	+ 4.1	
603	1894	...do	...do	23	......	1,200 gm. black bread, 60 gm. sugar, 3,000 cc. tea.	3	17.6	17.0	6.4	— 5.8	

604	1894	.....do	.....do	23	....	800 gm. white bread, 1,000 cc. milk, 293 gm. meat, 60 gm. sugar, 70 gm. butter, 2,250 cc. tea.	3	29.8	23.2	2.3	+ 4.3	

Nos. 539, 540. Arch. Psych., 15, p. 798, Table I. Nos. 541, 542. Ibid., Table II. No. 543. Trudi Russ. Obsh. Ochran. Narod. Zdravia, 12, p. 18. No. 544. Ibid., pp. 19, 23. No. 545. Ibid., p. 24. No. 546. Ibid., p. 25. No. 547. Ibid., pp. 26–28. No. 548. Ibid., p. 29. No. 549. Ibid., p. 31. Nos. 550, 551. Ibid., p. 32. Nos. 552–557. Proc. Royal Soc. Edinburgh, 16, p. 127. No. 558. Ztschr. klin. Med., 16, p. 604. Nos. 559, 560. Centbl. med. Wissensch., 1889, p. 833. No. 561. Ztschr. Biol., 25, p. 275. No. 562. Jahrb. Thier. Chem., 19, p. 384. No. 563. Virchow's Arch. path. Anat. u. Physiol., 131, Sup., p. 121. No. 564. Ibid., p. 67. Nos. 565–569. The influence of repeated periods of partial fasting on the nitrogen metabolism of healthy individuals. Inaug. Diss. (Russian), St. Petersburg, 1894, p. 52, Table 1. Nos. 570–574. Ibid., p. 54, Table 2. Nos. 575–579. Ibid., p. 56, Table 3. Nos. 580–584. Ibid., p. 58, Table 4. Nos, 585–589, Ibid., p, 60, Table 5. Nos. 590–594. Ibid., p. 62, Table 6. Nos. 595–599. Ibid., p. 64, Table 7. Nos. 600–604. Ibid., p. 66, Table 8.

Nos. 539–542 were made by Tuczek at the insane asylum in Marburg in 1883–84. The object was an investigation of the influence of fasting on metabolism. The subjects were two women. Both were suffering from some mental derangement and for a long time refused to take food. After the prolonged fast the subjects of their own accord took food. It consisted of soup, bread, meat, etc. The water and protein in the food consumed were calculated from Bauer's figures. The urea, phosphoric acid, sulphuric acid, and chlorin in the urine were determined, and tests were made for albumen, sugar, indican, and acetone. The nitrogen in the feces was calculated from König's coefficients of digestibility of the various articles of food.

The subject of No. 539 fasted for 22 days. She spent most of the time in bed. There were no feces for 17 days. The urine was free from albumen, sugar, and indican; it, however, gave a reaction for acetone. The patient drank a little water, about 175 cubic centimeters per day.

In No. 540, which immediately followed No. 539, the subject received at first a large quantity of liquid, over 2,000 cubic centimeters per day with the food, but only 400 cubic centimeters of urine was excreted per day. The long fast had evidently removed considerable water which is normally present in the body, and until this was made good the loss of liquid from the body was small. On the third day after the fast there was no acetone in the urine and on the fifth day indican was found.

The subject of No. 541 fasted for 28 days. The experiment covered 16 days, not consecutive, between the eighth and twenty-eighth day of the fasting period. During this time the patient drank a little water, beer, and broth, and ate a little orange. Feces were produced normally. In No. 542 the subject took some food.

The author gives many details of the conduct of the two subjects, and the experiments are discussed at some length from a medical standpoint. No conclusions were drawn.

Nos. 543–551 were made by Sadovyen at St. Petersburg in 1888. The object was to study the metabolism of man when fasting. The subject was a man. Three experiments are described. In the first (Nos. 543–545) the subject took food on the first and last days and fasted on 2 days; in the second (Nos. 546–548) he fasted partially or completely for 4 days and took food on the last day; in the third (Nos. 549–551) he consumed water, starch, and sugar, but no nitrogenous food. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method, the uric acid in the urine by Neubauer's or Salkovsky's method, and the phosphoric and hydrochloric acids in the urine by titrating with solutions of uranium nitrate and silver nitrate, respectively. The oxygen and hydrogen in the food were determined by elementary analyses. The respiratory quotient was determined by Pashutin's method.[1]

Among the conclusions reached were the following: As fasting continued the daily loss in weight of the subject diminished. In general, observations with man corroborate the law observed with animals, that the intensity of metabolism is inversely proportional to the size of the organism.

The outgo of nitrogen and uric acid diminished during fasting. This has been observed also with fasting animals, with this difference, however, that with man relatively less nitrogen is excreted and on the first days of fasting the outgo of nitrogen decreases more gradually than in animals.

Nos. 552–557 were made by Paton and Stockman in 1889 (?). The object was an investigation of the influence of fasting on metabolism. The subject was a French professional faster named Jacques. He fasted 40 days. He consumed considerable mineral water and smoked during the whole period. He took small quantities of a powder of vegetable origin prepared by himself. He would not reveal its composition. During the first half of the experiment he took daily walks. For the first few days feces were produced, then for 30 days none were excreted. A peculiarity of the experiment was that the subject drank considerable quantities of his own

[1] Vrach, 7, 1886, No. 18.

urine. It is not stated that this fact is taken into account in computing the results. Drinking urine for stomach troubles is customary among the peasants of the region of which Jacques was a native.

No. 558 was made by Klemperer in 1888 (?) to study the excretion of nitrogen during fasting. The subject was a patient in an insane asylum. For a long time he refused to take food. A little water was consumed. The nitrogen in the urine was determined. It is not stated that feces were excreted.

The author discusses his experiment and other experiments with fasting men, and concludes that in long-continued fasting the usual nitrogen excretion is from 3 to 5 grams per day.

This experiment formed part of an investigation of metabolism with subjects under various conditions. (See Nos. 370–375, Table 6.)

Nos. 559, 560 were made by Munk in Berlin in 1888 (?). The object was a study of the influence of fasting on metabolism. The subject was a healthy young man. For 6 days no food was consumed. For 2 days preceding and 2 days following the fasting period the food was carefully weighed and analyzed. The urine and feces for the 2 days following the fasting period were also analyzed. It had been said by some critics that the value for the nitrogen excretion which Zuntz had found in the case of the professional faster Cetti (No. 563) was too high and was due partly to disease. The nitrogen excretion of the subject of this experiment was the same as in the case of Cetti. On the mixed diet followed for 2 days the organism gained a large amount of nitrogen. This fact was attributed to the abundance of fat and carbohydrates furnished with the protein. The nitrogen excretion was less on these days than during the period of fasting.

The fact is pointed out that when the dietary contains little protein more calories of energy are required before nitrogen balance is reached than when there is an abundance of protein.

No. 561 was made for purposes of comparison with a vegetarian diet. (See Nos. 8–10, Table 1.)

No. 562 was made by Luciani. The subject was the professional faster Succi. The experiment is quoted by the compilers from a citation without details by Munk. The original publication[1] was not accessible. In discussing metabolism during fasting von Noorden[2] has quoted the experiment, giving some details. According to him the subject fasted 30 days. For 5 days before fasting on an average 16.2 grams of nitrogen was excreted in the urine. On the first 5 days of fasting the mean daily excretion was 12.9 grams. The excretion diminished until from the twenty-first to the twenty-fifth day the average was 4.7 grams, and from the twenty-sixth to the thirtieth day it was 5.3 grams.

Nos. 563 and 564 were made by Lehmann, Müller, Munk, Senator, and Zuntz, in Berlin in 1887 and 1888. The object was to study the effect of prolonged fasting on the organism. The subjects were the professional fasters Cetti and Breithaupt. They were closely watched during the whole time of the experiments. Cetti fasted ten days. His weight decreased from 57 to 50 kilograms, or 11.14 per cent. For the first 5 days the loss of weight was rapid; on the sixth and seventh days there was only a slight loss, and on the last 3 days a considerable loss.

Breithaupt fasted 6 days. His weight decreased from 60 to 56.45 kilograms, or 6.9 per cent. The loss was greatest on the third and fourth days. The subjects appeared thinner after fasting. Cetti's pulse remained about the same, but Breithaupt's was slower than usual. Cetti suffered during the whole time with pains similar to colic, and Breithaupt from a cold in the head and some inflammation of the bowels.

Feces were produced during the whole period, the average for Cetti being 22 grams per day and for Breithaupt 9.5 grams. In neither case was the loss of nitrogen

[1] Das Hungern., Leipzig, 1890. Translated from the Italian.

[2] Pathologie des Stoffwechsels, Berlin, 1893, p. 153.

through the feces very large. The ether extract of the feces consisted of fat, fatty acids, and salts of fatty acids, besides a little cholestrin. The ash contained a very little magnesia, but a large percentage of alkalies.

In both cases the sulphur in the urine was determined. In the case of Cetti the phosphoric acid balance was also determined.

Respiration experiments were made in which the respiratory quotient was determined, but no figures were given for the balance of income and outgo of carbon.

Nos. 565-604 were made by Gorokhov in St. Petersburg in 1894. The object was to determine the influence of repeated periods of partial fasting on nitrogen metabolism of healthy individuals. The subjects were 8 young men, physically well developed. The experiments were divided into five periods, of 3 days each. In the first, third, and fifth periods the subjects consumed normal quantities of bread, milk, meat, and butter. The first period was regarded as preliminary. In the second and fourth periods a moderate amount of black bread was consumed. The last two are regarded as periods of partial fasting. Throughout the whole experiment weak tea, with some sugar, was taken as a beverage.

The separation of the feces was made with blackberries. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The determinations were made in each portion of the food purchased and in the urine and feces daily. The ratio of neutral sulphur to acid sulphur in the urine was also determined. The neutral sulphur was estimated by taking the difference between the total sulphur and sulphur of sulphuric acid. The sulphur was estimated by Salkowski's method. From the ratio between neutral and acid sulphur inferences were drawn concerning the qualitative metabolism of protein. Further deductions were drawn from the amount of nitrogen of extractives, that is, the total nitrogen of the urine less the nitrogen of urea.

The following conclusions were reached: During the periods of partial fasting the assimilation of nitrogen was less complete than during normal periods and the organism lost nitrogen, i. e., some of its own tissue was metabolized. The amount of partially oxidized products in the urine increased. The quantity of urine decreased, although more water (tea) was consumed. The total quantity of dry matter of the feces increased. More nitrogen was lost during partial fasting than was gained during the following periods. The subjects gained in weight.

In the periods following the periods of partial fasting the assimilation of nitrogen improved and the metabolism decreased. The quantity of incompletely oxidized products in the urine was less than during the periods of partial fasting, but greater than during the preliminary period. The subjects lost weight.

EXPERIMENTS WITH DRUGS.

In Table No. 9 are included 243 tests with men, 2 with women, and 8 with children, in which various drugs, including many commonly used in medicine, were given with a more or less normal diet. The influence of a drug on the excretion of nitrogen is regarded as one of the most valuable indications of its physiological effect, and in many experiments with drugs the nitrogen balance has been determined in this connection. For instance, if a drug causes an increased excretion of nitrogen in the urine the conclusion seems warranted that this is due to increased cleavage of protein. Many of the experiments with dogs have been made to study the general laws of nutrition. Thus laxatives have been employed to see whether increasing the amount of feces increases the excretion of nitrogen also. Similar experiments of a similar nature with diseased subjects are found in Tables 17 to 23, and with animals in Tables 29, 31, 34, and 36.

TABLE 9.—*Experiments with drugs.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—)	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
605	1881	Höfler	Man	32	......	200 gm. milk, 300 gm. bread, 400 gm. meat, etc.	4	21.5	19.7	2.3	— 0.5	
606	1881	....do	....do	32	......	....do	3	21.5	22.0	2.3	— 2.8	Subject took Krankenheiler mineral water.
607	1881	Oppenheim	Observer	21	115	400 gm. bread, 300 gm. meat, 950 gm. milk	1	18.9	14.9	2.9	+ 1.1	Subject took coffee from 41 gm. coffee beans.
608	1881	....do	....do	21	......	....do	2	18.9	15.6	0.0	+ 3.3	Period after coffee.
609	1881	....do	....do	21	......	....do	1	18.9	18.0	0.5	+ 0.4	Subject took 2 gm. quinin.
610	1881	....do	....do	21	......	....do	2	18.9	16.3	1.4	+ 1.2	Period after quinin.
611	1881	....do	....do	21	......	....do	1	18.9	16.1	1.5	+ 1.3	Hypodermic injection of 0.02 gm. pilocarpin.
612	1881	....do	....do	21	......	....do	1	18.9	16.1	1.5	+ 1.3	Period after pilocarpin.
613	1881	....do	....do	21	......	....do	1	18.9	18.9	0.8	— 0.8	Subject took 2 gm. quinin.
614	1883	Schulze	Observer	......	......	120 gm. pork, 120 gm. beef, 55 gm. dry bread powder, 30 gm. cocoa powder, 30 gm. butter, 30 gm. sugar, 5 gm. salt, 1,500 cc. water.	10	9.2	11.2	1.4	— 3.4	On 3 days subject took 10 gm. potassium bromid.
615	1883	....do	....do	......	......	....do	3	9.2	11.5	1.2	— 3.5	Days with potassium bromid.
616	1883	....do	....do	......	......	....do	7	9.2	11.0	1.4	— 3.2	Days without potassium bromid.
617	1884	Forster	Physician (S.)	......	72	200 gm. meat, 500 gm. milk, 2 eggs, 120 gm. butter, 200 gm. potato, 250 gm. savoy cabbage, 300 gm. bread.	3	17.3	17.4	1.2	— 0.3	
617*a*	1884	....do	....do	......	......	....do	3	17.3	17.3	1.1	— 1.1	Subject took 3 gm. boric acid.
618	1884	....do	....do	......	......	....do	3	17.3	16.7	1.1	— 0.5	
619	1885	Chittenden and Cuthbert.	Observer (Cu.)	......	72	142 gm. beef, 283.5 gm. potatoes, 256 gm. bread, 50 gm. oatmeal, 56.7 gm. butter, 28.3 gm. sugar, 700 gm. milk, 345.5 gm. water.	9	(17.9)	16.5	(1.5)	— 0.1	
619*a*	1885	....do	....do	......	......	....do	6	(17.9)	17.0	(1.5)	— 0.6	Subject took 60–150 grains potassium bromid.
619*b*	1885	....do	....do	......	......	....do	12	(17.9)	15.6	(1.5)	+ 0.8	
620	1885	....do	....do	......	......	....do	4	(17.9)	16.4	(1.5)	0.0	Subject took 75–150 grains ammonium bromid.
621	1885	....do	....do	......	......	....do	2	(17.9)	15.3	(1.5)	+ 1.1	

TABLE 9.—*Experiments with drugs*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
622	1885	Chittenden and Whitehouse.	Observer (W.)		59	255 gm. beef, 255 gm. wheat bread, 149 gm. potatoes. 50 gm. oatmeal, 35 gm. butter, 21 gm. sugar, 570 gm. milk, 350 gm. water.	7	(21.2)	19.6	(1.5)	+ 0.1	
623	1885	.....do	.....do			.....do	4	(21.2)	17.5	(1.5)	+ 2.2	Subject took 15–50 grains cinchonidin sulphate.
624	1885	.....do	.....do			.....do	3	(21.2)	17.9	(1.5)	+ 1.8	Three days following No. 623.
625	1885	.....do	.....do					(21.2)	17.7	(1.5)	+ 2.0	Average of Nos. 623, 624.
626	1885	.....do	.....do			As in No. 622	3	(21.2)	20.1	(1.5)	— 0.4	
627	1885	.....do	.....do			.....do	2	(21.2)	19.2	(1.5)	+ 0.5	Subject took 45.8–50 grains cinchonidin sulphate.
628	1885	.....do	.....do			.....do	10	(21.2)	21.5	(1.5)	— 1.8	
629	1885	.....do	.....do			.....do	9	(21.2)	19.3	(1.5)	+ 0.4	Subject took 200 gm. glucose.
630	1885	.....do	.....do			.....do	4	(21.2)	23.9	(1.5)	— 0.6	
631	1886	Walter	Copyist (I.)	22	49.6	2,093 cc. milk	3	10.1	14.6	1.0	— 3.5	Pneumonia chronica.
632	1886	.....do	.....do	22	48.9	2,140 cc. milk	3	11.7	8.2	0.8	+ 2.7	Pneumonia chronica. Subject took 5 gm. antipyrin (nitrogen included in total income).
633	1886	.....do	Soldier (N.)	22	66.1	1,615 cc. milk	3	6.5	19.6	1.2	—14.3	Ileo typhus.
634	1886	.....do	.....do	22	63.7	1,600 cc. milk	3	6.9	12.1	1.4	—10.6	Ileo typhus. Subject took 6 gm. antipyrin (nitrogen included in total income).
635	1886	.....do	Copyist (L.)	25	57.8	2,200 cc. milk	2	12.1	19.0	2.8	— 9.7	Typhus exanthematicus.
636	1886	.....do	.....do	25	55.7	1,225 cc. milk	2	7.5	11.7	1.0	— 5.2	Typhus exanthematicus. Subject took 7.5 gm. antipyrin (nitrogen included in total income).
637	1886	.....do	Copyist (E.)	25	47.3	2,067 cc. milk	3	11.2	14.0	1.3	— 4.1	Tuberculosis.
638	1886	.....do	.....do	25	46.0	2,500 cc. milk	3	14.1	13.6	1.1	— 0.6	Tuberculosis. Subject took 6 gm. antipyrin (nitrogen included in total income).

639	1886	.....do	Soldier (I.)	22	66.1	1,433 cc. milk	3	6.1	12.1	2.6	— 8.6	Pleuropneumonia.
640	1886	.....do	.....do	22	63.7	910 cc. milk	3	5.1	8.6	3.0	— 6.5	Pleuropneumonia. Subject took 4.7 gm. antipyrin (nitrogen included in total income).
641	1886	.....do	Soldier (K.)	22	55.5	2,033 cc. milk	3	13.4	17.0	2.3	— 5.9	Pleuritis acuta dextra.
642	1886	.....do	.....do	22	54	1,990 cc. milk	3	13.9	12.5	2.3	— 0.9	Pleuritis acuta dextra. Subject took 5.3 gm. antipyrin (nitrogen included in total income).
643	1886	.....do	Soldier (M.)	22	59.2	2,667 cc. milk	3	12.3	22.3	1.8	—11.8	Pneumonia chronica.
644	1886	.....do	.....do	22	50	727 cc. milk	3	4.2	13.5	0.6	— 9.9	Pneumonia chronica. Subject took 5 gm. antipyrin (nitrogen included in total income).
645	1886	.....do	Man (V.)	23	61	1,180 cc. milk, 399 gm. bread, 250 gm. meat, 6,000 cc. bouillon.	3	31.3	27.0	2.2	+ 2.1	In health.
646	1886	.....do	.....do	23	62	1,183 cc. milk, 408 gm. bread, 250 gm. meat, 6,000 cc. bouillon.	3	29.9	22.9	1.8	+ 5.2	In health. Subject took 3 gm. antipyrin (nitrogen included in total income).
647	1886	.....do	Man (L.)	23	66	1,233 cc. milk, 568 gm. bread, 250 gm. meat, 600 cc. bouillon.	3	35.5	28.1	2.0	+ 5.4	In health.
648	1886	.....do	.....do	23	66.2	1,217 cc. milk, 605 gm. bread, 250 gm. meat, 600 cc. bouillon.	3	33.9	24.2	1.9	+ 7.8	In health. Subject took 3 gm. antipyrin (nitrogen included in total income).
649	1887	Gramatchikov and Ossendovski.	Medical student (O.)	....	60.8	172 gm. meat, 400 gm. bread, 1,152 gm. milk, 640 cc. tea.	5	20.9	18.4	1.1	+ 1.4	
650	1887	.....do	.....do	....	59.9	172 gm. meat, 479 gm. bread, 1,048 gm. milk, 640 cc. tea.	5	21.6	15.2	1.5	+ 4.9	Smoked 10–25 cigarettes daily.
651	1887	.....do	Medical student (G.)	....	56.6	159 gm. meat, 475 gm. bread, 1,132 gm. milk, 480 cc. tea.	5	20.4	17.6	1.3	+ 1.5	Smoked 25 cigarettes daily.
652	1887	.....do	.....do	....	56.7	158 gm. meat, 411 gm. bread, 1,250 gm. milk, 480 cc. tea.	5	21.2	19.1	1.0	+ 1.1	
653	1887	.....do	Medical student (O.)	....	62.7	156 gm. meat, 641 gm. bread, 600 gm. milk, 960 cc. tea.	5	25.6	17.8	2.2	+ 5.6	Smoked 10–25 cigarettes daily.
654	1887	.....do	.....do	....	61.8	142 gm. meat, 621 gm. bread, 600 gm. milk, 1,000 cc. tea.	5	22.1	19.3	1.4	+ 1.4	
655	1887	.....do	Medical student (G.)	....	58.4	145 gm. meat, 692 gm. bread, 760 gm. milk, 680 cc. tea.	5	27.1	20.7	1.5	+ 4.9	
656	1887	.....do	.....do	....	58.4	132 gm. meat, 617 gm. bread, 640 gm. milk, 800 cc. tea.	5	21.9	16.1	1.6	+ 4.2	Smoked 25 cigarettes daily.
657	1887	.....do	Hospital servant (Sh.).	....	66.8	300 gm. meat, 726 gm. bread, 360 gm. milk, 1,560 cc. tea.	5	32.6	23.7	2.6	+ 6.3	
658	1887	.....do	.....do	....	67.2	280 gm. meat, 799 gm. bread, 400 gm. milk, 1,600 cc. tea.	5	32.8	20.8	2.7	+ 9.3	Smoked — cigarettes daily.
659	1887	.....do	Man (B.)	....	51.6	300 gm. meat, 736 gm. bread, 400 gm. milk, 1,740 cc. tea.	5	32.9	23.0	1.3	+ 8.6	

TABLE 9.—*Experiments with drugs*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
660	1887	Gramatchikov and Ossendovski.	Man (B.)		51.9	280 gm. meat, 808 gm. bread, 400 gm. milk, 1,800 cc. tea.	5	33.9	19.9	2.6	+11.4	Smoked — cigarettes daily.
661	1888	Gorsky	Prisoner (V.)			300 gm. meat, 800 gm. bread, 600 cc. beef tea.	7	31.6	21.6	5.1	+ 4.9	
662	1888	do	do			do	10	34.1	27.1	3.4	+ 3.6	Subject took lithium carbonate.
663	1888	do	do			600 cc. beef tea (3 days), 300 gm. meat, 840 gm. bread.	7	33.6	27.3	1.7	+ 4.6	
664	1888	do	Prisoner (M.)			600 cc. beef tea, 300 gm. meat, 812 gm. bread.	7	31.8	22.8	2.3	+ 6.7	
665	1888	do	do			600 cc. beef tea, 300 gm. meat, 900 gm. bread.	10	36.2	28.0	2.2	+ 6.0	Do.
666	1888	do	do			600 cc. beef tea, 300 gm. meat.	7	35.2	24.1	1.6	+ 9.5	
667	1888	do	Prisoner (I.)			600 cc. beef tea, 300 gm. meat, 800 gm. bread.	7	31.6	21.8	2.1	+ 7.7	
668	1888	do	do			600 cc. beef tea, 300 gm. meat.	10	33.8	28.5	1.3	+ 4.0	Do.
669	1888	do	do			600 cc. beef tea, 300 gm. meat.	7	33.5	26.6	0.9	+ 6.0	
670	1889	Klemptner	Physician	23	72.1	280 gm. beef, 90 gm. butter, 100 gm. egg, 50 gm. cheese, 100 gm. white bread, 280 gm. black bread, 120 gm, potatoes, 20 gm. sugar 420 gm. milk, 350 cc. tea, 350 gm. bouillon, 850 cc. water, (139.6 fat, 252.2 carbohydrates).	6	23.6	22.6	(1.1)	— 0.1	Preliminary period (normal)
671	1889	do	do	23	71.9	do	5	23.6	23.6	(1.1)	— 1.1	Soda water containing 3.2 gm. sodium carbonate and 1.08 gm. salt.
672	1889	do	do	23	71.6	do	8	23.6	22.8	(1.1)	— 0.3	Soda water containing 5 gm. sodium carbonate.
673	1889	do	do	23	72.3	do	8	23.6	22.9	(1.1)	— 0.4	Soda water containing 9 gm. sodium carbonate, 4 gm. citric acid, 0.05 gm. saccharin.
674	1889	do	do	23	71.3	do	3	23.6	23.0	(1.1)	— 0.5	Soda water containing 18 gm. sodium carbonate, 8 gm. citric acid, 0.1 gm. saccharin.
675	1889	do	do	23	71.3	do	1	23.6	21.4	(1.1)	+ 1.1	Normal period.
676	1889	do	do	23	71.3	do	14	23.6	22.7	(1.1)	— 0.2	Soda water containing 9–30 gm. sodium carbonate, and corresponding quantities of citric acid and saccharin.

677	1889	....do	....do	23	70.4	....do	3	23.6	23.0	(1.1)	— 0.5	Normal period.
678	1889	Burchard	Observer	....	55.8	340 gm. beef, 70 gm. potatoes, 110 gm. bread, 75 gm. butter, 40 gm. cheese, 40 gm. sugar, 40 gm. rice, 30 gm. cream, 300 gm. soup, 230 cc. tea, 290 gm. coffee, 1,000 cc. beer (87.6 fat, 155.8 carbohydrates).	7	16.9	16.6	0.8	— 0.5	Do.
679	1889	....do	....do	....	55.8	....do	7	16.9	16.7	(0.8)	— 0.6	
680	1889	....do	....do	....	55.4	....do	7	16.9	16.0	(0.8)	+ 0.1	Subject took sodium carbonate in soda water.
681	1889	....do	....do	....	56.0	....do	8	16.9	13.8	(0.8)	+ 2.3	Subject took sodium citrate in soda water.
682	1889	....do	....do	....	55.6	....do	8	16.9	15.6	1.6	— 0.3	Do.
683	1889	....do	....do	....	54.7	....do	7	16.9	17.3	1.2	— 1.6	Do.
684	1889	....do	....do	....	54.0	....do	7	16.9	15.9	0.9	+ 0.1	
685	1889	Ippolitov	Child (D.)	5½	19.6	120 gm. meat, 303 gm. bread, 751 cc. milk	5	11.6	10.6	1.4	— 0.4	Scrofulous ulcers on cheeks; normal diet.
686	1889	....do	....do	5½	20.0	127 gm. meat, 315 gm. bread, 750 cc. milk	7	12.5	10.0	1.1	+ 1.4	Scrofulous ulcers on cheeks; subject took white cod-liver oil.
687	1889	....do	....do	5½	20.2	125 gm. meat, 321 gm. bread. 750 cc. milk	7	13.0	11.6	1.2	+ 0.2	Scrofulous ulcers on cheeks; subject took almond oil.
688	1889	....do	Child (P.)	7½	20.2	180 gm. meat, 285 gm. bread, 540 cc. water, 192 cc. tea.	5	13.8	11.5	1.6	+ 0.7	Scofula; normal diet.
689	1889	....do	....do	7½	20.6	180 gm. meat, 305 gm. bread, 433 cc. milk, 174 cc. gruel, 632 cc. water, 137 cc. tea.	7	14.2	11.4	1.7	+ 1.1	Scrofula; subject took almond oil.
690	1889	....do	....do	7½	21.2	178 gm. meat, 293 gm. bread, 400 cc. milk, 236 gruel, 629 cc. water, 280 cc. tea.	7	13.9	10.8	1.9	+ 1.2	Scrofula; subject took white cod-liver oil.
691	1889	....do	Child (T.)	6	17.0	150 gm. meat, 292 gm. bread, 418 cc. milk, 572 cc. water.	5	12.1	10.4	1.3	+ 0.4	Lymphatic glands enlarged; normal diet.
692	1889	....do	....do	6	17.3	150 gm. meat, 299 gm. bread, 460 cc. milk, 490 cc. water.	7	12.3	10.3	1.4	+ 0.6	Lymphatic glands enlarged; normal diet; subject took white cod-liver oil.
693	1889	....do	....do	6	17.7	150 gm. meat, 299 gm. bread, 460 cc. milk, 515 cc. water.	7	12.9	10.5	1.4	+ 1.0	Subject took lipanin.
694	1889	....do	Child (S.)	6	14.5	150 gm. meat, 300 gm. bread, 476 cc. milk, 688 cc. water.	5	12.2	10.5	1.9	— 0.2	Lymphatic glands enlarged; normal diet.
695	1889	....do	....do	6	14.8	150 gm. meat, 293 gm. bread, 476 cc. milk, 479 cc. water.	7	12.6	10.1	1.6	+ 0.9	Subject took lipanin.
696	1889	....do	....do	6	15.0	150 gm. meat, 291 gm. bread, 476 cc. milk, 437 cc. water.	7	13.1	10.4	1.8	+ 0.9	Subject took white cod-liver oil.
697	1889	....do	Child (I.)	7	18.4	175 gm. meat, 306 gm. bread, 470 cc. milk, 536 cc. water.	5	13.1	12.1	0.6	+ 0.4	Lymphatic glands slightly enlarged; normal diet.
698	1889	....do	....do	7	18.6	175 gm. meat, 300 gm. bread, 470 cc. milk, 514 cc. water.	7	13.6	12.7	0.9	0.0	Lymphatic glands slightly enlarged; subject took yellow cod-liver oil.

TABLE 9.—*Experiments with drugs*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
699	1889	Ippolitov	Child (I.)	7	19.0	175 gm. meat, 301 gm. bread, 470 cc. milk, 562 cc. water.	7	14.2	13.1	0.8	+ 0.3	Lymphatic glands slightly enlarged; subject took white cod-liver oil.
700	1889	....do	Child (K.)	7	19.0	175 gm. meat, 300 gm. bread, 480 cc. milk, 501 cc. water.	5	13.2	12.0	1.3	— 0.1	Lymphatic glands enlarged; normal diet.
701	1889	....do	....do	7	19.3	173 gm. meat, 305 gm. bread, 480 cc. milk, 807 cc. water.	7	13.4	10.8	1.6	+ 1.0	Lymphatic glands enlarged; subject took white cod-liver oil.
702	1889	....do	....do	7	19.5	175 gm. meat, 301 gm. bread, 480 cc. milk, 766 cc. water.	7	13.9	11.8	1.7	+ 0.4	Lymphatic glands en larged; subject took yellow cod-liver oil.
703	1889	....do	Child (K.)	7	17.2	160 gm. meat, 291 gm. bread, 476 cc. milk, 354 cc. water.	5	12.6	11.0	0.8	+ 0.8	Lymphatic glands enlarged; normal diet.
704	1889	....do	....do	7	17.2	159 gm. meat, 295 gm. bread, 476 cc. milk, 466 cc. water.	7	12.7	10.5	1.0	+ 1.2	Lymphatic glands enlarged; subject took white cod-liver oil.
705	1889	....do	....do	7	17.2	160 gm. meat, 296 gm. bread, 476 cc. milk, 320 cc. water.	7	13.3	11.2	1.1	+ 1.0	Lymphatic glands enlarged; subject took morrhuol.
706	1889	....do	Child (T.)	6	16.9	170 gm. meat, 290 gm. bread, 510 cc. milk, 340 cc. water.	5	13.4	11.0	1.2	+ 1.2	Lymphatic glands enlarged; normal diet.
707	1889	....do	....do	6	17.2	170 gm. meat, 291 gm. bread, 510 cc. milk, 557 cc. water.	7	14.2	11.6	1.4	+ 1.2	Lymphatic glands enlarged; subject took morrhuol.
708	1889	Aikinov	Peasant (I.)	19	55.2	20 gm. blackberries (1 day), 1,068 cc. milk, 600 cc. tea, 250 cc. water, 331 gm. bouillon, 255 gm. oatmeal (2 days).	4	7.2	17.2	1.2	—11.2	Typhoid fever.
709	1889	....do	....do	19	54.9	20 gm. blackberries (1 day), 720 gm. milk, 149 gm. bread, 262 gm. broth with tata albumen (1 day), 854 gm. blackberries, with tata powder (3 days), 454 gm. jelly of tata gelatin (3 days), 1,050 cc. tea, 181 cc. water.	4	14.0	16.0	1.6	— 3.6	Typhoid fever; subject took tata albumen preparations.
710	1889	....do	....do	19	56.1	20 gm. blackberries (1 day), 583 gm. milk (2 days), 523 gm. bread, 164 gm. oatmeal (2 days), 1,952 gm. milk, — gm. soup, 980 gm. manna (2 days), 282 gm. blueberry jelly (1 day).	4	27.8	11.8	1.7	+ 1.3	Do.

711	1889	.....do	Peasant woman (R.).	23	38.6	20 gm. blackberries (1 day), 115 gm. bread, 337 gm. soup, 47 gm. boiled meat, 64 gm. cutlet (3 days), 30 gm. gravy (3 days), 247 gm. rice (1 day), 108 gm. curd (2 days), 113 gm. buckwheat (2 days), 337 gm. oatmeal (2 days), 598 cc. tea.	4	9.5	7.6	2.2	— 0.3	Pneumonia chronica bacillaris.
712	1889	.....do	.....do	23	38.0	20 gm. blackberries (1 day), 79 gm. bread, 319 gm. soup (1 day), 41 gm. boiled meat (1 day), 35 gm. roast meat, 33 gm. cutlet (3 days), 19 gm. gravy (3 days), 422 gm. soup from tata powder (2 days), 235 gm. jelly of tata gelatin (2 days), 643 cc. tea.	4	8.1	6.3	1.8	0.0	Pneumonia chronica bacillaris. Subject took tata albumen preparations.
713	1889	.....do	.....do	23	38.0	20 gm. blackberries (1 day), 60 gm. bread, 209 gm. soup, 29 gm. boiled meat, 261 gm. blueberry jelly, 51 gm. roast meat, 67 gm. buckwheat (2 days), 89 gm. oatmeal (2 days), 655 cc. tea.	4	6.3	4.6	2.0	— 0.3	Pneumonia chronica bacillaris.
714	1889	.....do	Painter (K.)	15	38.1	20 gm. blackberries (1 day), 74 gm. bread (3 days), 288 gm. half-white bread, 358 gm. soup, 93 gm. cutlet (2 days), 20 gm. gravy, 405 gm. rice (3 days), 1,193 cc. tea, 1,000–1,500 cc. water.	4	9.7	9.9	0.9	— 1.1	Hysteria.
715	1889	.....do	.....do	15	38.2	20 gm. blackberries (1 day), 168 gm. bread, 185 gm. half-white bread (2 days), 592 gm. soup with tata powder, 120 gm. jelly from tata gelatin, 1,206 cc. tea, 1,000–1,500 cc. water.	4	12.4	11.6	1.0	— 0.2	Hysteria. Subject took tata albumen preparations.
716	1889	.....do	.....do	15	37.8	20 gm. blackberries (1 day), 89 gm. bread, 156 gm. half-white bread, 554 gm. soup, 92 gm. cutlet (2 days), 37 gm. gravy (1 day), 304 gm. rice (2 days), 1,366 cc. tea, 1,000–1,500 cc. water.	4	8.0	10.9	1.5	— 4.4	Hysteria.
717	1889	.....do	Lamplighter (V.) ...	23	55.8	20 gm. blackberries (1 day), 279 gm. bread, 391 gm. half-white bread, 543 gm. soup, 103 gm. cutlet (3 days), 22 gm. gravy (3 days), 376 gm. rice (1 day), 289 gm. buckwheat (2 days), 342 gm. millet (2 days), 208 gm. roast meat (3 days), 1,100–1,300 cc. tea.	4	26.1	24.0	2.0	+ 0.1	Pneumonia chronica bacillaris.
718	1889	.....do	.....do	23	56.7	20 gm. blackberries (1 day), 258 gm. bread, 395 gm. half-white bread, 568 gm. soup, 91 gm. cutlet (3 days), 14 gm. gravy (3 days), 423 gm. rice (1 day), 412 gm. buckwheat (2 days), 469 gm. millet (2 days), 109 gm. roast meat (1 day), 280 gm. blackberries with tata powder, 343 gm. jelly from tata gelatin, 1,100–1,300 cc. tea.	4	27.8	21.9	2.6	+ 4.3	Pneumonia chronica bacillaris. Subject took tata albumen preparations.
719	1889	.....do	.....do	23	56.9	20 gm. blackberries, 219 gm. bread, 408 gm. half-white bread, 549 gm. soup, 111 gm. cutlet (2 days), 28 gm. gravy (2 days), 408 gm. rice (2 days), 374 gm. buckwheat (2 days), 377 gm. millet (2 days), 118 gm. roast meat, 1,100–1,300 cc. tea.	4	20.2	17.6	2.2	+ 0.4	Pneumonia chronica bacillaris.

TABLE 9.—*Experiments with drugs*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
720	1889	Aikinov	Laborer (V.)	36	42.5	20 gm. blackberries (1 day), 143 gm. half-white bread, 579 gm. soup, 109 gm. cutlet, 25 gm. gravy, 120 gm. roast meat (3 days), 402 gm. roast beef (3 days), 745 gm. milk (2 days), 840 cc. tea, 1,500 cc. water.	4	29.4	26.5	4.5	— 1.6	Diabetes mellitus.
721	1889	do	do	36	43.3	20 gm. blackberries (1 day), 147 gm. half-white bread, 809 gm. soup (3 days), 134 gm. cutlet, 44 gm. gravy, 88 gm. roast meat, 741 gm. milk (3 days), 149 gm. rice with tata powder, 131 gm. jelly from tata gelatin, 840 cc. tea, 1,500 cc. water.	4	23.6	24.7	4.3	— 5.4	Diabetes mellitus. Subject took tata albumen preparations.
722	1889	do	do	36	43.8	20 gm. blackberries (1 day), 153 gm. half-white bread, 976 gm. soup, 136 gm. cutlet, 26 gm. gravy, 190 gm. roast meat (2 days), 225 gm. roast beef (2 days), 750 gm. milk, 840 cc. tea, 1,500 cc. water,	4	25.1	18.3	4.4	+ 2.4	Diabetes mellitus.
723	1889	do	Waiter (S.)	16	38.1	20 gm. blackberries (1 day), 1,092 gm. milk, 421 gm. broth, 623 cc. tea, 400-600 cc. water.	2	6.9	12.6	5.9	—11.6	Typhus abdominalis.
724	1889	do	do	16	36.8	20 gm. blackberries (1 day), 1,065 gm. milk, 188 gm. broth (1 day), 178 gm. jelly from tata gelatin, 489 gm. broth with tata powder (3 days), 704 cc. tea, 400-600 cc. water.	4	9.2	13.0	4.3	— 8.1	Typhus abdominalis. Subject took tata albumen preparations.
725	1889	do	do	16	36.2	20 gm. blackberries (1 day), 990 gm. milk, 395 gm. broth, 480 cc. tea, 400-600 cc. water.	2	6.3	11.4	4.0	— 9.1	Typhus abdominalis.
726	1889	do	Tradesman (M.)	17	45.0	20 gm. blackberries (1 day), 336 gm. broth, 1,607 gm. milk, 995 cc. tea, 300-400 cc. water.	2	9.3	12.3	0.8	— 3.8	Typhoidea.
727	1889	do	do	17	43.8	20 gm. blackberries (1 day), 308 gm. broth, 1,347 gm. milk, 150 gm. broth with tata powder, 224 gm. jelly from tata gelatin, 737 cc. tea, 450-600 cc. water.	4	12.6	16.4	2.2	— 6.0	Typhoidea. Subject took tata albumen preparations.
728	1889	do	do	17	45.0	321 gm. broth, 734 gm. milk, 620 cc. tea	1	4.7	13.6	2.6	—11.5	Typhoidea.
729	1889	do	Cabman (Z.)	21	57.6	20 gm. blackberries (1 day), 225 gm. bouillon, 1,164 gm. milk, 325 cc. tea, 600-800 cc. water.	3	7.2	17.5	4.2	—14.5	Typhus abdominalis.

730	1889	....do	....do	21	55.4	20 gm. blackberries (1 day), 1,166 gm. milk, 257 gm. soup, with tata powder, 146 gm. jelly from tata gelatin (5 days), 470 cc. tea, 600–1,000 cc. water.	8	10.4	20.6	1.0	—11.2	Typhus abdominalis. Subject took tata preparations.
731	1889	....do	....do	21	53.2	20 gm. blackberries (1 day), 225 gm. bouillon, 1,168 gm. milk, 541 cc. tea, 600–1,000 cc. water.	3	7.3	16.0	1.8	—10.5	Typhus abdominalis.
732	1889	....do	Laborer (V.)	20	49.4	20 gm. blackberries (1 day), 208 gm. bread, 375 gm. soup, 47 gm. boiled meat, 230 gm. rice (1 day), 149 gm. cutlet (2 days), 225 gm. gruel (2 days).	3	11.7	7.2	0.8	+ 3.7	Pneumonia chronica bacillaris.
733	1889	....do	....do	20	49.0	20 gm. blackberries (1 day), 154 gm. bread, 187 gm. soup (3 days), 42 gm. boiled meat (3 days), 252 gm. rice (2 days), 126 gm. cutlet (20 days), 187 gm. cake with preserves (2 days), 251 gm. soup (16 days), 85 gm. curd (1 day), 68 gm. chicken (1 day), 226 gm. gruel (11 days), 85 gm. egg (1 day), 286 gm. soup with tata powder (11 days), 300 gm. soup with tata powder (9 days), 282 gm. rice with tata powder (3 days), 144 gm. jelly from tata gelatin (5 days), 405 gm. milk (2 days).	22	12.9	11.7	1.0	+ 0.2	Pneumonia chronica bacillaris. Subject took tata preparations.
734	1889	....do	Cook (B.) (woman)	52	42.3	955 cc. milk, 94 gm. cutlet	3	8.9	4.2	1.1	+ 3.6	Ulcus ventriculi rotundum et morbus bacedowii.
735	1889	....do	....do	52	41.4	955 cc. milk, 26 gm. cutlet (1 day), 60 gm. pork fat (1 day), 116 gm. soup with tata powder (8 days), 108 gm. jelly from tata gelatin (6 days), 221 gm. rice with tata powder (1 day).	9	7.4	5.5	0.9	+ 1.0	Ulcus ventriculi rotundum et morbus bacedowii. Subject took tata preparations.
736	1889	....do	....do	52	40.4	956 cc. milk	3	5.5	2.5	1.0	+ 2.0	Ulcus ventriculi rotundum et morbus bacedowii.
737	1889	....do	Tradesman (G.)	20	47.0	20 gm. blackberries (1 day), 1,125 cc. milk, 266 gm. bouillon, 850 cc. tea, 700–1,000 cc. water.	3	6.0	14.4	0.7	— 9.1	Typhus abdominalis lævis.
738	1889	....do	....do	20	46.0	20 gm. blackberries (1 day), 755 cc. milk, 201 gm. soup with tata powder, 274 gm. gruel with tata powder, 850–1,200 cc. tea, 700–1,000 cc. water.	4	8.1	15.8	1.0	— 8.7	Typhus abdominalis lævis. Subject took tata preparations.
739	1889	....do	....do	20	45.2	20 gm. blackberries (1 day), 1,160 cc. milk, 265 gm. bouillon, 281 gm. blueberry jelly, 1,100 cc. tea, 700–1,000 cc. water.	3	6.4	11.1	0.8	— 5.5	Typhus abdominalis lævis.
740	1890	Kozerski	Observer		74.7	200 gm. beef, 200 gm. ham, 1 egg, 34 gm. meat extract, 125 gm. butter, 350 gm. white bread, 120 gm. potato, 96 gm. sugar, 1,435 cc. tea, 170 gm. jam, 150 cc. coffee, 250 gm. water (138.1 fat, 321.2 gm. carbohydrates).	12	23.7	20.9	1.9	+ 0.9	Preliminary period.
741	1890	....do	....do		74.9	....do	5	23.7	20.4	3.2	+ 0.1	Subject took 3 to 13 gm. sodium carbonate.

TABLE 9.—*Experiments with drugs*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
742	1890	Kozerski	Observer		75.5	200 gm. beef, 200 gm. ham, 1 egg, 34 gm. meat extract, 125 gm. butter, 350 gm. white bread, 120 gm. potato, 96 gm. sugar, 1,435 cc. tea, 170 gm. jam, 100 cc. coffee, 250 gm. water (138.1 fat, 321.2 gm. carbohydrates).	8	23.7	21.1	2.5	+0.1	Subject took 13 gm. sodium carbonate.
743	1890	do	do		74.7	do	3	23.7	20.4	3.2	+0.1	Supplementary period.
744	1890	Navasartianz	Observer	33	80.1	187 gm. white bread, 388 gm. cutlet, 50 gm. sturgeon, 458 gm. bouillon, 1,476 gm. manna, 1,267 cc. water, 325 cc. wine.	6	20.4	18.4	1.7	+0.3	
745	1890	do	do	33	80.0	162 gm. white bread, 84 gm. cutlet (1 day), 226 gm. sturgeon (3 days), 317 gm. chicken (2 days), 320 gm. roast beef, 282 gm. lamb (2 days), 367 gm. bouillon, 250 gm. manna (1 day), 1,133 cc. tea, 303 wine, 300 cc. mineral water.	6	21.3	19.3	2.6	—0.6	Subject took Essentuki mineral water No. 17.
746	1890	do	do	33	79.5	153 gm. white bread, 531 gm. cutlet (2 days), 292 gm. chicken (2 days), 223 gm. lamb (2 days), 119 gm. beef tea (1 day), 112 gm. cheese (1 day), 266 gm. cabbage (1 day), 400 cc. bouillon, 268 gm. manna, 1,167 cc. tea, 282 cc. wine.	6	20.7	18.2	2.3	+0.2	
747	1890	do	Physician (M.)	29	72.6	146 gm. white bread, 358 gm. cutlet, 116 gm. sturgeon (3 days), 567 gm. bouillon, 283 gm. manna (2 days), 1,233 cc. water, 325 cc. wine.	6	18.7	16.9	1.0	+0.8	
748	1890	do	do	29	71.7	91 gm. white bread, 177 gm. cutlet (1 day), 213 gm. sturgeon (3 days), 279 gm. chicken (2 days), 387 gm. roast beef (2 days), 168 gm. lamb (2 days), 400 gm. bouillon, 280 gm. manna (1 day), 1,300 cc. tea, 347 cc. wine, 300 cc. mineral water.	6	19.0	17.9	1.1	0.0	Do.
749	1890	do	do	29	71.7	103 gm. white bread, 543 gm. cutlet (2 days), 334 gm. chicken (3 days), 61 gm. lamb (1 day), 184 gm. beefsteak (1 day), 151 gm. cheese (1 day), 187 gm. cabbage (1 day), 400 gm. bouillon, 228 gm. manna (1 day), 1,467 cc. tea, 370 cc. wine.	6	18.4	17.3	0.9	+0.2	
750	1890	do	Physician (A.)	36	56.9	163 gm. white bread, 359 gm. cutlet, 91 gm. sturgeon (3 days), 400 gm. bouillon, 219 gm. manna (2 days), 1,333 cc. tea, 317 cc. wine.	6	18.5	17.2	0.6	+0.7	

751	1890	.....do	.....do	36	55.9	123 gm. white bread, 182 gm. cutlet (1 day), 181 gm. sturgeon (2 days), 220 gm. chicken (2 days), 411 gm. roast beef (2 days), 237 gm. lamb (3 days), 400 cc. bouillon, 245 gm. manna (1 day), 1,250 cc. tea, 287 cc. wine, 300 cc. mineral water.	6	19.7	18.8	0.8	+0.1	Do.
752	1890	.....do	.....do	36	56.7	92 gm. white bread, 511 gm. cutlet (2 days), 360 gm. chicken (3 days), 175 gm. lamb (2 days), 122 gm. cheese (1 day), 112 gm. beefsteak (1 day), 252 gm. cabbage (1 day), 400 gm. bouillon, 232 gm. manna (1 day), 1,300 cc. tea, 282 cc. wine.	6	20.4	19.1	0.9	+0.4	
753	1890	.....do	Janitor (N.)	22	69.0	359 gm. white bread, 317 gm. cutlet, 170 gm. sturgeon (1 day), 500 gm. bouillon, 52 gm. blueberries, 1,000 cc. tea, 533 cc. water.	6	20.0	18.3	1.1	+0.6	
754	1890	.....do	.....do	22	68.0	404 gm. white bread, 191 gm. sturgeon (2 days), 244 gm. chicken (2 days), 268 gm. roast beef (2 days), 187 gm. lamb (2 days), 500 gm. bouillon, 64 gm. blueberries (1 day), 1,067 cc. tea, 500 cc. water, 300 cc. mineral water.	6	21.4	20.4	1.6	—0.6	Do.
755	1890	.....do	.....do	22	68.0	438 gm. white bread, 226 gm. cutlet (2 days), 238 gm. chicken (3 days), 173 gm. lamb (2 days), 141 gm. beefsteak (1 day), 64 gm. cheese (1 day), 567 cc. water.	6	23.0	22.3	1.4	—0.7	
756	1890	Kotlyar	Medical student (U.)	23	65	600 gm. white bread, 300 gm. meat, 1,200 cc. milk, 60 gm. butter, 200 gm. bouillon, 1,200 gm. tea, 60 gm. sugar.	5	24.7	20.8	0.9	+3.0	
757	1890	.....do	.....do	23	65	.....do	5	25.7	22.0	0.8	+2.9	Subject took 6 to 12 grains orexini muriatici.
758	1890	.....do	.....do	23	66	.....do	5	26.4	21.8	1.3	+3.3	
759	1890	.....do	Nurse (Ya.)	19	60	400 gm. white bread, 200 gm. meat, 800 cc. milk, 60 gm. butter, 200 gm. bouillon, 1,400 gm. tea, 60 gm. sugar.	5	16.6	15.8	1.0	—0.2	
760	1890	.....do	.....do	19	60	440 gm. white bread, 200 gm. meat, 800 cc. milk, 60 gm. butter, 200 gm. bouillon, 1,400 gm. tea, 60 gm. sugar.	5	17.8	14.8	0.8	+2.2	Do.
761	1890	.....do	.....do	19	60	.....do	5	18.1	16.3	1.1	+0.7	
762	1890	.....do	Medical student (M.)	24	69	400 gm. white bread, 250 gm. meat, 50 gm. butter, 1,000 cc. milk, 1,200 gm. tea, 100 gm. sugar, 5 gm. salt.	5	22.2	13.9	2.0	+6.3	
763	1890	.....do	.....do	24	69	460 gm. white bread, 642 gm. meat, 50 gm. butter, 1,000 cc. milk, 1,200 gm. tea, 100 gm. sugar, 5 gm. salt.	5	25.3	14.3	1.4	+9.6	Subject took 5 grains orexini muriatici.
764	1890	.....do	Laborer (P.)	32	58	400 gm. white bread, 175 gm. meat, 29 gm. butter, 729 cc. milk, 800 gm. tea, 50 gm. sugar, 5 gm. salt.	4	17.6	14.2	2.2	+1.2	
765	1890	.....do	.....do	32	57	438 gm. white bread, 138 gm. meat, 29 gm. butter, 456 cc. milk, 950 gm. tea, 50 gm. sugar, 5 gm. salt.	4	17.2	15.8	1.2	+0.2	Catarrh of the stomach.

TABLE 9.—*Experiments with drugs*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
766	1890	Kotlyar	Laborer (P.)	32	57	451 gm. white bread, 150 gm. meat, 39 gm. butter, 375 cc. milk, 1,150 gm. tea, 63 gm. sugar, 5 gm. salt.	4	18.3	13.8	3.2	+ 1.3	Catarrh of the stomach. Subject took 5 grains orexini muriatici.
767	1890	....do	Peasant (M.)	57	55	382 gm. white bread, 25 gm. butter, 541 cc. milk, 1,200 gm. tea, 74 gm. sugar.	4	10.8	10.6	0.5	— 0.3	Cancer pyroli.
768	1890	....do	....do	57	55	372 gm. white bread, 40 gm. butter, 356 cc. milk, 1,500 gm. tea, 84 gm. sugar.	4	10.7	10.4	0.3	0.0	Cancer pyroli. Subject took 5 grains orexini muriatici.
769	1890	....do	Peasant (M.)	27	67	401 gm. white bread, 200 gm. meat, 28 gm. butter, 500 cc. milk (2 days), 1,400 gm. tea, 75 gm. sugar, 8 gm. salt.	4	17.3	17.3	1.2	— 1.2	Catarrh of the stomach.
770	1890	....do	....do	27	67	508 gm. white bread, 200 gm. meat, 43 gm. butter, 438 cc. milk, 1,350 gm. tea, 71 gm. sugar, 8 gm. salt.	4	21.1	16.3	1.6	+ 3.2	Catarrh of the stomach. Subject took 5 grains orexini muriatici.
771	1890	....do	Peasant (Ya.)	45	54	304 gm. white bread, 200 gm. meat, 48 gm. butter, 500 cc. milk, 850 gm. tea, 28 gm. sugar, 5 gm. salt.	4	16.7	14.3	0.2	+ 2.2	Catarrh of the stomach and incipient chronic pneumonia.
772	1890	....do	....do	45	55	400 gm. white bread, 200 gm. meat, 50 gm. butter, 500 cc. milk, 1,200 gm. tea, 38 gm. sugar, 5 gm. salt.	4	19.1	15.0	0.4	+ 3.7	Catarrh of the stomach and incipient chronic pneumonia. Subject took 5 grains orexini muriatici.
773	1890	Savatski	Hospital servant (A.).	23	65	370 gm. meat, 501 gm. bread, 1,040 gm. milk, 76 gm. butter, 1,800 gm. tea or water.	5	24.8	22.0	3.2	— 0.4	
774	1890	....do	....do	23	65	395 gm. meat, 509 gm. bread, 1,020 gm. milk, 73 gm. butter, 1,964 gm. tea or water.	5	27.5	22.2	2.0	+ 3.3	Subject took 0.2 gm. saccharin.
775	1890	....do	Student (Ya.)	20	66	370 gm. meat, 483 gm. bread, 1,080 gm. milk, 70 gm. butter, 1,528 gm. tea or water.	5	24.0	27.2	1.0	— 4.2	
776	1890	....do	....do	20	66	392 gm. meat, 507 gm. bread, 1,060 gm. milk, 68 gm. butter, 1,472 gm. tea or water.	5	27.2	26.7	0.9	— 0.4	Do.
777	1890	....do	Servant (Z.)	23	61	392 gm. meat, 500 gm. bread, 500 gm. milk, 63 gm. butter, 2,020 gm. tea or water.	5	23.8	19.0	2.1	+ 2.7	
778	1890	....do	....do	23	61	386 gm. meat, 500 gm. bread, 500 gm. milk, 70 gm. butter, 2,040 gm. tea or water.	5	28.4	22.0	1.8	+ 4.6	Subject took 0.4 gm. saccharin.
779	1890	....do	Hospital servant (S.)	21	60	392 gm. meat, 501 gm. bread, 1,000 gm. milk, 70 gm. butter, 1,500 gm. tea or water.	5	26.9	21.6	2.1	+ 3.2	
780	1890	....do	....do	21	60	386 gm. meat, 500 gm. bread, 1,000 gm. milk, 70 gm. butter, 1,540 gm. tea or water.	5	31.7	22.5	2.1	+ 7.1	Do.

781	1890	.....do	Physician (Ch.)	32	67	392 gm. meat, 229 gm. bread, 714 gm. milk, 40 gm. butter, 1,890 gm. tea or water.	5	20.8	19.0	1.8	0.0	
782	1890	.....do	.....do	32	67	389 gm. meat, 310 gm. bread, 470 gm. milk, 42 gm. butter, 2,000 gm. tea or water.	5	24.0	19.9	1.0	+ 3.1	Do.
783	1890	Chittenden and Washburn.	Student		66	312 gm. beef, 368 gm. potato, 227 gm. wheat bread, 149 gm. boiled rice, 35 gm. butter, 25 gm. sugar, 6 gm. salt, 1,200 gm. water.	14	(18.5)	17.0	(1.5)	0.0	
784	1890	.....do	.....do			.....do	5	(18.5)	16.0	(1.5)	+ 1.0	Subject took 5 to 22 grains of urethan.
785	1890	.....do	.....do			.....do	7	(18.5)	18.3	(1.5)	— 1.3	
786	1890	.....do	.....do			.....do	3	(18.5)	17.5	(1.5)	— 0.5	Subject took 20 to 39 grains of urethan.
787	1890	.....do	.....do			.....do	5	(18.5)	19.7	(1.5)	— 2.7	
788	1890	Chittenden and Adams.	Student		77	368 gm. beef, 340 gm. potato, 227 gm. wheat bread, 163 gm. oatmeal, 28 gm. sugar, 42 gm. butter, 120 gm. milk, 1,040 gm. water.	11	(22.1)	19.7	(1.5)	+ 0.9	
789	1890	.....do	.....do			.....do	5	(22.1)	18.1	(1.5)	+ 1.5	Subject took 30 to 54 grains of antipyrin.
790	1890	.....do	.....do			.....do	7	(22.1)	19.8	(1.5)	+ 0.8	
791	1890	.....do	.....do			.....do	5	(22.1)	19.3	(1.5)	+ 1.3	Subject took 40 to 60 grains of antipyrin.
792	1890	.....do	.....do			.....do	5	(22.1)	20.8	(1.5)	— 0.2	
793	1891	Badt	Woman	40		840 cc. "Bolle's Modified Milk" (4.6 gm. nitrogen, 26.9 gm. fat, 37.8 gm. carbohydrates).	5	1.0	16.5	0.2	—15.7	Subject took phosphorus; vomited 11 gm. fat, 18.2 gm. carbohydrates, 3.6 gm. nitrogen (not included in nitrogen consumed).
794	1891	.....do	.....do	40		650 cc. "Bolle's Modified Milk," 9 Zwieback, 200 cc. bouillon (1 day), (4 gm. nitrogen, 21 gm. fat, 35.6 carbohydrates).	5	3.4	17.0	0.9	—14.5	Subject took phosphorus; vomited 19 gm fat, 32 gm. carbohydrates, 0.6 gm. nitrogen (not included in nitrogen consumed).
795	1892	Dronke and Ewald	Woman	21		400 cc. bouillon, 600 cc. milk	6	3.5	5.9	0.3	— 2.7	Subject took Levico arsenic-iron water.
796	1892	.....do	.....do	21		Milk, meat, vegetables, etc	14	11.1	5.9	0.7	+ 4.5	Do.
797	1892	.....do	.....do	21		Milk, meat, vegetables	3	7.3	4.5	0.5	+ 1.3	First 3 days of No. 796.
798	1892	.....do	.....do	21		Milk, meat	1	16.7	13.4	0.4	+ 2.9	Last day of No. 796.
799	1892	.....do	.....do	21		Milk, meat, vegetables, eggs, etc	8	16.6	10.5	1.4	+ 4.7	Subject took Levico arsenic-iron water.
800	1893	Volkov and Stadnitski.	Hospital servant			Bread, meat, milk, butter, water	4	25.5	20.6	1.5	+ 3.4	
801	1893	.....do	.....do			.....do	4	26.0	22.4	2.4	+ 1.2	Subject took 0.3 gm. potassium iodid twice a day.
802	1893	.....do	.....do			.....do	4	24.7	21.2	1.8	+ 1.7	
803	1893	.....do	Hospital servant			.....do	4	25.5	21.8	1.8	+ 1.9	
804	1893	.....do	.....do			.....do	4	26.0	22.5	1.9	+ 1.6	Do.
805	1893	.....do	.....do			.....do	4	24.7	21.2	1.8	+ 1.7	
806	1893	.....do	Hospital servant			.....do	4	25.5	19.9	1.1	+ 4.5	
807	1893	.....do	.....do			.....do	4	26.0	20.9	1.8	+ 3.3	Do.
808	1893	.....do	.....do			.....do	4	24.7	20.1	1.2	+ 3.4	
809	1893	.....do	Hospital servant			.....do	4	23.4	20.7	1.2	+ 1.5	

TABLE 9.—*Experiments with drugs*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
810	1893	Volkov and Stadnitski.	Hospital servant			Bread, meat, milk, butter, water	4	22.2	22.3	1.7	—1.8	Subject took 0.3 gm. potassium iodid twice a day.
811	1893	do	do			do	4	23.5	21.3	1.0	+1.2	
812	1893	do	Hospital servant			do	4	23.4	22.7	1.5	—0.8	
813	1893	do	do			do	4	22.2	23.1	2.1	—3.0	Do.
814	1893	do	do			do	4	23.5	20.6	1.7	+1 2	
815	1893	do	Hospital servant			do	4	23.4	22.5	1.1	—0.2	
816	1893	do	do			do	4	22.2	22.6	1.8	—2.2	Do.
817	1893	do	do			do	4	23.5	22.4	1.6	—0.5	
818	1893	Von Noorden	Laboratory servant.			104.4 gm. protein, 79.3 gm. fat, 354 gm. carbohydrates, 2,700 gm. water.	2	16.7	13.8	0.8	+2.1	
819	1893	do	do			do	3	18.0	15.9	1.8	+0.3	Subject took 4 gm. pipirizin.
820	1893	Jawein	Man (I)		63.4	200-300 gm. meat, 600-700 gm. bread, 50-100 gm. butter, 600-800 cc. milk, 50-100 gm. sugar, 1,000-2,000 cc. tea.	4	20.5	19.3	1.3	—0.1	
821	1893	do	do		63.8	do	4	20.5	18.7	1.9	—0.1	Subject took 20 gm. sodium carbonate.
822	1893	do	do		63.4	do	4	22.6	20.0	1.8	+0.8	
823	1893	do	Man (II)		61.4	do	4	24.1	17.3	0.8	+6.0	
824	1893	do	do		62.3	do	4	22.1	18.5	1.2	+2.4	Do.
825	1893	do	do		61.8	do	4	23.6	20.8	1.0	+1.8	
826	1893	do	Man (III)		60.9	do	4	23.9	16.8	0.9	+6.2	
827	1893	do	do		61.2	do	4	22.1	18.0	1.3	+2.8	Do.
828	1893	do	do		60.8	do	4	23.8	21.5	1.2	+1.1	
829	1893	do	Man (IV)		76.0	do	4	23.7	21.6	1.5	+0.6	
830	1893	do	do		76.5	do	4	23.0	21.8	1.8	—0.6	Do.
831	1893	do	Man (V)		70.1	do	4	23.7	20.5	1.6	+1.6	
832	1893	do	do		70.0	do	4	23.0	19.5	1.3	+2.2	Do.
833	1893	do	Man (VI)		60.9	do	4	20.5	17.5	2.4	+0.6	
834	1893	do	do		61.2	do	4	20.9	18.6	2.2	+0.1	Do.
835	1893	do	do		59.5	do	4	20.5	19.2	2.1	—0.8	
836	1893	do	Man (VII)		62.1	do	4	21.8	18.9	1.8	+1.1	
837	1893	do	do		61.8	do	4	22.8	20.0	1.9	+0.9	Do.
838	1893	do	do		62.6	do	4	21.9	19.8	2.0	+0.1	
839	1893	do	Man (X)		59.0	do	4	26.2	23.1	2.0	+1.1	
840	1893	do	do		59.8	do	4	25.8	21.5	2.5	+1.8	Do.
841	1893	do	Man (XI)		77.2	do	4	25.4	22.7	1.7	+1.0	
842	1893	do	do		77.7	do	4	24.8	20.5	2.0	+2.3	Do.

843	1893	.....do	Man (VIII)	....	66.3	.....do	4	18.5	16.1	1.4	+1.0	
844	1893	.....do	.....do	....	66.4	.....do	4	17.5	15.1	1.4	+1.0	Do.
845	1893	.....do	Man (IX)	....	61.2	.....do	4	18.1	15.5	1.3	+1.3	
846	1893	.....do	.....do	....	62.0	.....do	4	17.5	16.2	1.3	0.0	Do.
847	1893	.....do	Man (X)	....	59.0	.....do	4	26.2	23.1	2.0	+1.1	
848	1893	.....do	.....do	....	59.2	.....do	4	27.6	23.3	2.2	+2.1	Subject took 40 gm. sodium citrate.
849	1893	.....do	Man (XI)	....	77.2	.....do	4	25.4	22.7	1.7	+1.0	
850	1893	.....do	.....do	....	77.1	.....do	4	25.9	22.2	2.9	+0.8	Do.
851	1894	Helmers	Observer	....	....	250 gm. meat, 60 gm. sausage, 275 gm. bread, 120 gm. butter, 40 gm. potato, 30 gm. sugar, 750 cc. beer (93.2 gm. protein, 125.6 gm. fat, 270.5 gm. carbohydrates, 2,659 calories).	2	14.9	14.1	1.0	—0.2	
852	1894	.....do	.....do	....	....	.....do	2	14.9	12.8	1.7	+0.4	Subject took 4.6 gm. ichthyol-ammonium.
853	1894	.....do	.....do	....	....	.....do	4	14.9	12.7	1.3	+0.9	
854	1894	.....do	.....do	....	....	250 gm. meat, 50 gm. sausage, 40 gm. Edam cheese, 250 gm. bread, 50 gm. rice, 120 gm. butter, 30 gm. sugar, 500 cc. beer (99.2 gm. protein, 132.6 gm. fat, 263.8 gm. carbohydrates, 2,722 calories).	4	15.9	14.9	1.3	—0.3	
855	1894	.....do	.....do	....	....	.....do	4	15.9	14.6	1.1	+0.2	Subject took 4.2 gm. ichthyol-ammonium.
856	1894	.....do	.....do	....	....	.....do	3	15.9	14.7	1.4	—0.2	
857	1894	.....do	.....do	....	....	.....do	3	15.9	14.4	1.2	+0.3	

Nos. 605, 606. Deut. med. Wochenschr., 1881, p. 147. Nos. 607–613. Pflüger's Arch. Physiol., 23, p. 497. Nos. 614–616. Ztschr. Biol., 19, p. 305. Nos. 617, 618. Arch. Hyg., 2, pp. 91–99. Nos. 619–621. Studies from the Laboratory of Physiological Chemistry of Yale College, 1884–85, pp. 152–155. Nos. 622–625. Ibid., pp. 160, 161. Nos. 626, 627. Ibid., p. 162. No. 628. Ibid., p. 168. Nos. 629, 630. Ibid., p. 169. Nos. 631, 632. The influence of antipyrin on the metabolism and assimilation of nitrogen in fever patients and healthy persons. Inaug. Diss. (Russian), St. Petersburg, 1886, Table 1. Nos. 633, 634. Ibid., Table 2. Nos. 635, 636. Ibid., Table 3. Nos. 637, 638. Ibid., Table 4. Nos. 639, 640. Ibid., Table 5. Nos. 641, 642. Ibid., Table 6. Nos. 643, 644. Ibid., Table 7. Nos. 645, 646. Ibid., Table 8. Nos. 647, 648. Ibid., Table 9. Nos. 649–660. The influence of smoking upon man. Vrach, 8, pp. 45, 46. Nos. 661–669. Influence of lithium carbonate on the metabolism of nitrogen in healthy man. Inaug. Diss. (Russian), St. Petersburg, 1888, pp. 23, 24. No. 670. Ueber die Stickstoff und Harnsäureausscheidung bei Zufuhr von kohlensaurem resp. citronsaurem Natron. Inaug. Diss., Dorpat, 1889, pp. 12, 13. No. 671. Ibid., pp. 12–15. No. 672. Ibid., pp. 12, 17. No. 673. Ibid., pp. 12, 19. Nos. 674, 675. Ibid., pp. 12, 21. No. 676. Ibid., pp. 12, 23. No. 677. Ibid., pp. 12, 26. Nos. 678, 679. Ueber den Einfluss des kohlensauren resp. citronsauren Natrons auf den Stoffwechsel speciell auf die Stickstoffausscheidung. Inaug. Diss., Dorpat, 1889, pp. 29, 33. No. 680. Ibid., pp. 29, 37. No. 681. Ibid., p. 43. No. 682. Ibid., p. 51. No. 683. Ibid., p. 54. No. 684. Ibid., p. 57. Nos. 685–687. Influence of the internal use of cod-liver oil on the metabolism of nitrogen by children. Inaug. Diss. (Russian), St. Petersburg, 1889, Table 1, p. 38. Nos. 688–690. Ibid., Table 2, p. 40. Nos. 691–693. Ibid., Table 3, p. 42. Nos. 694–696. Ibid., Table 4, p. 44. Nos. 697–699. Ibid., Table 5, p. 46 Nos. 700–702. Ibid., Table 6, p. 48. Nos. 703–705. Ibid., Table 7, p. 50. Nos. 706, 707. Ibid., Table 8, p. 52. Nos. 708–710. On feeding patients with alkaline albuminates of eggs (artificial tata albumen). Inaug. Diss. (Russian), St. Petersburg, 1889, Table 14. Nos. 711–713. Ibid., Table 15. Nos. 714–716. Ibid., Table 16. Nos. 717–719. Ibid., Table 17. Nos. 720–722. Ibid., Table 18. Nos. 723–725. Ibid., Table 19, p. 47. Nos. 726–728. Ibid., Table 20. Nos. 729–731. Ibid., Table 21. Nos. 732, 733. Ibid., Table 22. Nos. 734–739. Ibid., Table 23. No. 740. Experimentelle Untersuchungen über den Einfluss des Kohlensauren Natron auf den menschlichen Stoffwechsel. Inaug. Diss. Dorpat, 1890, pp. 27, 30. No. 741. Ibid., pp. 14, 33, 34. No. 742. Ibid., pp. 14, 37, 39. No. 743. Ibid., pp. 14, 43. Nos. 744–747. The influence of Essentuki mineral water No. 17 on the assimilation and metabolism of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1890, Table 1. Nos. 748, 749. Ibid., Table 2. Nos. 750–752. Ibid., Table 3. Nos. 753–755. Ibid., Table 4. Nos. 756–758. The influence of orexin on the appetite, and on the metabolism and assimilation of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1890, Table 1. Nos. 759–761. Ibid., Table 2. Nos. 762, 763. Ibid., Table 3. Nos. 764–766. Ibid., Table 4. Nos. 767, 768. Ibid., Table 5. Nos. 769, 770. Ibid., Table 6. Nos. 771, 772. Ibid., Table 7. Nos. 773, 774. The influence of Fahlberg's saccharin on the metabolism and assimilation of nitrogen by healthy persons. Inaug. Diss. (Russian), St. Petersburg, 1890, p. 37. Nos. 775, 776. Ibid., p. 38. Nos. 777, 778. Ibid., p. 39. Nos. 779, 780. Ibid., p. 40. Nos. 781, 782. Ibid., p. 41. Nos. 783–787. Trans. Connecticut Acad. Art and Sci., vol. 8, Pt. I, 1890, pp. 41, 42. Nos. 788–792. Ibid., pp. 50–52. Nos. 793, 794. Kritische und klinische Beiträge zur Lehre vom Stoffwechsel bei Phosphorvergiftung. Inaug. Diss. Berlin, 1891, pp. 28, 31. Nos. 795–797. Berl. klin. Wochenschr., 1892, pp. 456–486. Nos. 798, 799. Ibid., p. 488. Nos. 800–817. Vrach, 14, p. 295. Nos. 818, 819. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 2, p. 117. Nos. 820–850. Ztschr. klin. Med., 22, p. 52. Nos. 851–857. Virchow's Arch., 135, pp. 135, 138–140.

Nos. 605, 606 were made by Höfler in 1881 (?). The object was to investigate the influence of Krankenheiler mineral water upon metabolism. The subject was a healthy young man. The food consisted of a simple mixed diet. The experiment was divided into two periods, and in the second Krankenheiler mineral water and Krankenheiler salts were taken with the food. This mineral water contains in 750 cubic centimeters 1.45 grams of sodium chlorid, 1.15 grams of sodium carbonate, and 0.15 gram of sodium sulphate. The nitrogen in the food was determined. The specific gravity, urea, sodium chlorid, and phosphoric and sulphuric acids in the urine were determined, and the nitrogen in the feces was assumed by the author from Renke's figures.

The conclusion was reached that the Krankenheiler mineral water increased the appetite and the amount of urine and also the metabolism of protein, as was shown by the increased amount of urea, uric acid, sodium chlorid, and phosphoric acid excreted.

Nos. 607–613. See Nos. 872–887, Table 10.

Nos. 614–616 were made by Schulze in the laboratory of the Department of Physiological Chemistry of the University of Breslau in 1882 (?). The object was to investigate the influence of potassium bromid on metabolism. The investigator himself was the subject. The diet consisted of bread, meat, butter, cocoa, etc. On three days potassium bromid was taken in 10-gram doses. The food, urine, and feces were analyzed. It was found that potassium bromid had no influence on the temperature of the body. The conclusion was reached that it produced a marked diminution of the nerve power and of the amount of matter metabolized by the nervous system. This conclusion was based on the fact that potassium bromid diminishes the excretion of phosphorus in the urine. If less metabolized phosphorus was excreted it was thought to be because the nerve centers had been less active than usual.

Nos. 617, 618 were made by Forster at the University of Amsterdam in 1882 in connection with a study of boric acid as a food preservative. The subject was a healthy physician. The test was divided into three periods. The food consisted of a simple mixed diet. In the second period 3 grams of boric acid was taken daily. The feces were separated by means of milk and eggs. The food, urine, and feces were analyzed.

The conclusion was reached that boric acid had no influence on the metabolism of protein. It, however, diminished somewhat the absorption of nutrients in the intestines. Its extended use as a food preservative is not recommended.

Nos. 619–621 were made by Chittenden and Cuthbert at the Laboratory of Physiological Chemistry at Yale College in 1884. The object was to study the influence of potassium and ammonium bromids on metabolism. The subject was one of the investigators (Cuthbert). He was of good physique and vigorous constitution. The food consisted of beef, bread, potatoes, oatmeal, etc. The periods with potassium or ammonium bromid were preceded and followed by normal periods. The reaction, specific gravity, total solids, phosphoric acid, phosphoric acid in combination with calcium and magnesium, and the uric acid and urea in the urine were determined. The nitrogen in the urine was calculated by the compilers from the uric acid and urea. The nitrogen of the feces was assumed by the compilers from experiment No. 83, Table 2, in which the diet was similar. The composition of the food was calculated by the compilers from standard tables.[1]

The following conclusions were reached: Potassium bromid increased the metabolism of nitrogen and slightly diminished the excretion of phosphoric acid. Ammonium bromid increased the metabolism of protein more than potassium bromid, while the phosphoric acid excretion remained practically unchanged.

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[1] Professor Chittenden has stated to the compilers that the composition of the food used in these and other experiments made by him was determined, although it was not published. The laboratory books containing these data have been mislaid, and the original data could not be obtained for publication in this compilation.

Nos. 622–630 were made by Chittenden and Whitehouse at the Laboratory of Physiological Chemistry at Yale College in 1884. The object was to study the influence of cinchonidin sulphate on metabolism. The subject was one of the investigators (Whitehouse). The food consisted of beef, bread, potatoes, oatmeal, etc. Periods in which cinchonidin sulphate was given were preceded and followed by periods of normal diet. The reaction, specific gravity, total solids, chlorin, phosphoric acid, uric acid, and urea in the urine were determined. The nitrogen in the urea was calculated by the compilers from the urea and uric acid. The nitrogen of the food was calculated by the compilers from standard tables, and that in the feces was supplied from experiment No. 83, Table 2, in which the diet was similar.

The conclusions were reached that cinchonidin sulphate diminished the excretion of urea, and the effect was noticed for some days after the last dose of the alkaloid was taken. The excretion of uric acid did not appear to be correspondingly increased. The excretion of phosphoric acid was diminished.

An experiment was made in which glucose was added to the normal diet, in order to determine whether the diminished excretion of phosphoric acid was due to some specific influence of the cinchonidin sulphate or to the general decrease of metabolism of protein. If the diminished excretion of phosphoric acid was due to the latter cause, it might be expected to take place also when the amount of carbohydrates in the diet was increased. It was found that under the influence of glucose the average amount of urea excreted was diminished 10 per cent and phosphoric acid 8.34 per cent, while with cinchonidin sulphate the average decrease in the excretion of urea was 8.8 per cent and of phosphoric acid 11.9 per cent. "Consequently, it would appear that while cinchonidin lowers the rate of decomposition of proteid matter in the body, it also has an effect upon the decomposition of some phosphorized principles, that being the only plausible explanation of the increased diminution of phosphoric acid noticed under the influence of the cinchonidin salt."

Nos. 631–648 were made by Walter in St. Petersburg in 1886. The object was to study the influence of antipyrin on the metabolism and assimilation of nitrogen in fever patients and healthy persons. Nine experiments are described. The subjects in Nos. 631–644 were suffering from various diseases and in Nos. 645–648 they were healthy. Each experiment was divided in two periods, one without antipyrin and one with antipyrin. The diseased subjects received no food except milk. They drank water and a beverage made from red bilberries (*Vaccinium vitis-idæa*), and took from 5 to 7.5 grams of antipyrin per day during the second period. The healthy subjects consumed milk, bread, bouillon, and roast beef, and took 3 grams of antipyrin per day during the second period. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author sums up his results as follows: Under the influence of antipyrin the metabolism of protein decreased in all the subjects, and the assimilation of protein improved in the cases of fever subjects and was not affected in the healthy subjects.

Nos. 649–660. Gramatchikov and Ossendovski made in St. Petersburg in 1887 an extended study of the influence of [cigarette] smoking on the organism of man. The influence of [cigarette] smoking on the metabolism and assimilation of nitrogen formed a part of this investigation.

A number of experiments of 10 days' duration were made, divided into two periods of 5 days each and preceded by a preliminary period of 5 days under the same dietary conditions. None of the subjects smoked during this period. The subjects were healthy men except B., who was troubled slightly with rheumatism. O. had never before smoked, B. was a moderate smoker, and the others were in the habit of smoking a large number of cigarettes daily. In all the experiments except Nos. 651–654 the subjects smoked during the second period, but did not smoke during the first period. In these two experiments the conditions were reversed. The number of cigarettes smoked per day was left to the inclination of the subjects. The food consisted of a mixed diet, varying somewhat in quantity for the different subjects. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The authors draw the following conclusions: Smoking [cigarettes] lowers the ratio of the nitrogen of the urine to that assimilated, i. e., lowers the metabolism, this decrease being especially marked in the case of nonsmokers making their first attempts at smoking. Smoking [cigarettes] also lowers the assimilation of the nitrogenous constituents of the food. No conclusions can be drawn on the basis of these experiments as to the influence of smoking [cigarettes] on the weight of the body.

Nos. 661–669 were made by Gorsky in St. Petersburg in 1888. The object was to study the influence of lithium carbonate on the metabolism of nitrogen in healthy persons. The subjects were 3 men. Each experiment continued 24 days, and was divided into three periods, the first and third of 7 and the second of 10 days' duration. During the first and third periods the subjects were under normal conditions. During the second period each subject received lithium carbonate in gradually increasing amounts, the dose on the first day being 2 grains and on the tenth day 8 grains. Water charged with carbonic dioxid was given as the best solvent for lithium, and 250 cubic centimeters were consumed daily. Lithium carbonate dissolved in carbonated water irritates the gastro-intestinal canal less than any other preparation.

The subjects were perfectly healthy prisoners confined in the St. Petersburg House of Detention. The food consisted of white bread, roasted meat, and beef tea. As a beverage each subject received 2,250 cubic centimeters of weak tea.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. Urea was determined by Borodin's method and uric acid by Haycraft's method.

The results of all 3 experiments are concordant, and lead to the following conclusions: The metabolism of nitrogen and the quantity of urea and uric acid were considerably increased under the influence of lithium carbonate. The increase of urea was still greater after the period when lithium was taken, while the quantity of uric acid was less.

Nos. 670–677 were made by Klemptner at the University of Dorpat in 1889. The object was to study the influence of sodium carbonate and sodium citrate upon the excretion of nitrogen and uric acid. The subject was a physician. The food consisted of a simple mixed diet. In several tests sodium carbonate or sodium citrate and saccharin were taken in soda water with the food. The composition of the food was calculated from König's tables. The nitrogen in the urine was determined by the Liebig-Pflüger method and by the Kjeldahl method. The uric acid was also determined. The nitrogen in the feces was calculated from Rubner's figures.

The following conclusions were reached: Even small doses of sodium carbonate and sodium citrate caused marked variations in the nitrogen excretion. When the dose was gradually increased to a large one and taken for a long time the variations became less marked and the organism more nearly in nitrogen equilibrium. The mean excretion of nitrogen was very little increased by sodium citrate. Both the citrate and carbonate had a diuretic action, and even when large doses of sodium citrate were consumed no dyspepsia resulted. Doses of sodium citrate of 15 grams and over caused an alkaline reaction in the urine. Large doses diminished the excretion of uric acid.

The author does not agree with Burchard, Nos. 678–684, that large doses of sodium citrate diminish the metabolism of protein in the organism and cause an increase in weight.

Nos. 678–684 were made by Burchard at the University of Dorpat in 1889. The object was to study the effect of sodium carbonate and citrate upon metabolism and especially upon the excretion of nitrogen. The author himself was the subject. He was 1.64 meters tall and in perfect health. The food consumed consisted of a simple mixed diet. In one case sodium carbonate was taken, and in several other cases sodium carbonate, citric acid, and saccharin were taken in the form of soda water. The nitrogen of the food was calculated from König's tables. The nitrogen in the urine was determined by the Liebig-Pflüger method and also by the Kjeldahl

method with Pflüger's modifications. The ammonia, uric acid, and chlorids in the urine were also determined, and in some instances the nitrogen in the feces. In the other cases the nitrogen in the feces was calculated.

The following conclusions were reached: Sodium citrate in large doses when taken for a long time did not produce dyspepsia. It had a diuretic effect and made the urine decidedly alkaline. Sodium citrate for a time diminished the metabolism of nitrogen and caused a gain of nitrogenous material. This period was, however, limited, for soon the weight of the body decreased and at the same time the nitrogen excretion was abnormally increased. Sodium citrate decreased the ammonia excretion to a minimum. While the decomposition of protein was increased the decomposition of fat was also increased, or the water in the organism was diminished. The excretion of uric acid was diminished and the complete assimilation of nutrients in the intestines was disturbed. Small doses of sodium carbonate had no effect upon the nitrogen excretion in the urine.

The after effect of long-continued large doses of sodium citrate upon the nitrogen content of the urine and feces was limited to 4 or 5 days. The increased consumption of water did not diminish the excretion of uric acid, but did remove nitrogenous materials already formed in the organism.

Nos. 685–707 were made by Ippolitov in St. Petersburg in 1889. The object was to study the influence of the internal use of cod-liver oil on the metabolism of nitrogen in children. From a survey of the literature on the therapeutical effects of cod-liver oil the author concludes that there are two opposite opinions, each of which has many supporters. Some (the majority) regard cod-liver oil only as a fat, easily digested, owing to the presence of free fatty acids, while others consider the fats of no consequence and attribute all importance to special constituents of the oil. Recently two articles which are intended to replace cod-liver oil have appeared. Mering proposed "lipanin" (a preparation of olive oil with 5 to 6 per cent of oleic acid), which, in his opinion, has none of the bad properties and all the advantages of cod-liver oil; and Lafage proposed "morrhuol," in which there is no fat, but which, in his opinion, represents the active principle of cod-liver oil.

Eight experiments were undertaken, although the eighth was not completed, to study the influence of cod-liver oil on the metabolism of nitrogen, to compare it with common vegetable oil, "lipanin" and "morrhuol," and also to compare white and yellow cod-liver oil. The subjects were children, hospital patients. Each experiment lasted 19 days, and was divided into three periods. In the first period (5 days) no remedy was given; in the second period (9 days) 4 subjects received white cod-liver oil and the others either almond oil, "lipanin," "morrhuol," or yellow cod-liver oil; and in the third period (7 days) the conditions were reversed. The oil was administered twice a day in doses of a dessert-spoonful before meals. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. In 5 cases the nitrogen of the urea, extractives, and uric acid in the urine was also determined. Borodin's method for urea and Haycraft's method for uric acid was used.

The following conclusions were reached: The internal use of white cod-liver oil diminished the metabolism of nitrogen, and almond oil and "lipanin" diminished it in a less degree. Yellow cod-liver oil and "morrhuol" slightly increased the metabolism of nitrogen. Cod-liver oil, almond oil, and "lipanin" did not materially influence the assimilation of nitrogen. Satisfactory gains in weight were made while using white cod-liver oil, better gains while using "lipanin," and less satisfactory gains while using almond oil and yellow cod-liver oil. The qualitative metabolism of the children was approximately the same as that of adults.

Nos. 708–739 were made by Aikinov in St. Petersburg in 1889. The object was to study the effect of feeding alkaline albuminates, i. e., artificial tata albumen. Tata albumen was discovered by Tarchanov. He found that in the fresh eggs of birds which are not covered with feathers when hatched there is a special kind of albumen. On boiling this albumen becomes transparent and gelatinous. It received the name of tata albumen. Tarchanov also devised a method for preparing tata albumen from

the white of hen's eggs. All the usual qualitative tests for albumen are applicable to tata albumen also. However, it has one peculiarity, i. e., a strong odor when treated with water. Tata albumen is prepared in two forms, a jelly and a powder. Both have a stronger alkaline reaction than the white of eggs. The author quotes the composition of tata albuminates from a dissertation by Malachowski on "Chemical composition and assimilation of potassium and sodium albuminates (tata albuminates)," St. Petersburg, 1889.

Composition of tata albuminates.

	Water.	Nitrogen.	Ether extract.	Ash.	Potassium oxid.	Sodium oxid.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Potassium tata powder	8.610	12.800	1.441	7.860	2.076	....
Sodium tata powder	8.413	12.738	1.461	7.672	....	1.313
Tata jelly	88.705	1.343	.290	2.199	....	.519

Eleven experiments on the food value of tata albuminates were made. The subjects were men suffering from some disease. In 5 experiments the food, urine, and feces were analyzed; in the remaining 6 the food was not analyzed, but its composition was calculated from available data. The nitrogen in all cases was determined by the Kjeldahl-Wilfarth method, the urea by the Pflüger method, and the uric acid by the Haycraft method. Each experiment was divided into three periods. During the second period the subjects were given the tata albuminates (jelly and sodium powder). In the first and third periods the dietary conditions were normal.

The following conclusions were reached: The patients ate the tata albumen preparations quite willingly. The alkaline albuminates did not cause vomiting, symptoms of dyspepsia, or diarrhea. The alkaline albuminates were as well assimilated as the milk casein or meat of a mixed diet. When tata albumen was consumed the qualitative metabolism of nitrogen improved and the cleavage of protein was more complete. Alkaline albuminates will probably prove valuable in diseases where abundant nourishment is the chief problem.

Nos. 740–743 were made by Kozerski at the University of Dorpat in 1890. The object was to study the influence of sodium carbonate upon metabolism. The author himself was the subject. The food consisted of a simple mixed diet. In two tests sodium carbonate was also consumed. The composition of the food was calculated from König's tables. The nitrogen, sodium, and potassium in the urine and feces, and the chlorin in the urine were determined.

The following conclusions were reached: Sodium carbonate in large doses had a slightly diuretic action, but did not produce a loss of weight. When the dose was 7 grams per day or larger the urine became alkaline. Sodium carbonate caused an increased excretion of chlorin, sodium, and potassium. When taken in amounts not exceeding 13 grams daily it was entirely absorbed in the intestines. When sodium carbonate was no longer taken the urine soon became acid and the chlorin and potassium excretion became normal. The after effect of sodium carbonate on sodium excretion was not marked. With the exception of the acid reaction of the urine the after effects of sodium carbonate were only noticed for 1 day. Large doses somewhat diminished the digestibility of the food. No constant effect could be observed on the excretion of urea. In general the effect of sodium carbonate was the same as that observed by Beckmann for sodium citrate, except that no storing up of sodium in the organism was observed.

Nos. 744–755 were made by Navasartianz in St. Petersburg in 1890. The object was to study the influence of Essentuki mineral water No. 17 on the assimilation and metabolism of nitrogenous substances. Essentuki, a village in the province of the Terek, Caucasus, is situated 603 meters above the level of the sea. The chemical

composition of the Essentuki mineral springs is well known in Russia, and especially that designated No. 17. The characteristic ingredients of this mineral water are sodium carbonate, sodium chlorid, and carbonic acid free and combined.

The experiments described were made with 4 subjects at Essentuki—the author, 2 physicians, and a laboratory janitor. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The urea was determined by the method of Chavane and Richet. The subjects had 3 meals a day, the food being as varied as practicable. Red wine was also allowed. The subject of Nos. 753–755 did not take wine. He was given blackberries for separating the feces; the others took manna for this purpose. All the experiments were carried on simultaneously. They lasted 18 days, and were divided into three periods of 6 days each. Mineral water was taken during the second period, the amount being 300 cubic centimeters daily for each person. The water, which was of the temperature of the room, was taken in two portions, 150 cubic centimeters in the morning on an empty stomach, and 150 cubic centimeters 4 or 5 hours after dinner.

The author sums up the results obtained as to the influence of the internal use of Essentuki mineral water No. 17 as follows: There was a decrease of extractives, an increase of urea, and a decrease of uric acid in the urine. The metabolism of nitrogenous substances was increased. There was an increased excretion of bile and a general improvement of the digestion. The quantity of feces increased and the assimilation as a whole and the weight of the body decreased. The reaction of the urine changed from acid to slightly acid or neutral. The quantity of urine decreased and the specific gravity increased.

Nos. 756–772 were made by Kotlyar in St. Petersburg in 1890. The object was to study the influence of orexin (phenyldihydroquinazolin) on the appetite and metabolism and assimilation of nitrogen in healthy and diseased subjects, and also on the assimilation of fats by diseased subjects. Three experiments are described with healthy and 4 with diseased subjects. The experiments were divided into two or three periods. The food consisted of a mixed diet. In every case 5 to 12 grams of orexin hydrochlorate was taken daily during the second period. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: Orexin increased the assimilation of nitrogen of healthy and diseased subjects and the assimilation of fat of diseased subjects. The metabolism of nitrogen was lowered in healthy and diseased subjects, though in the latter case the decrease was neither as marked nor as constant as in the former. In all cases the appetite and general condition were improved.

Nos. 773–782 were made by Savatski in St. Petersburg in 1890. The object was to study the influence of saccharin on the metabolism and assimilation of nitrogen in healthy subjects. Five experiments are described, each lasting 10 days, divided into two equal periods. The food consisted of a mixed diet. Tea was consumed as a beverage. In the second period saccharin was added to the tea instead of sugar. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The conclusion was reached that daily doses of 0.2 to 0.4 gram of saccharin increased the assimilation and decreased the metabolism of nitrogen in healthy subjects.

Nos. 783–787 were made by Chittenden and Washburn at the Laboratory of Physiological Chemistry at Yale University in 1888 (?). The object was to study the influence of urethan on the metabolism of protein. The subject was a healthy man. The food consisted of beef, potatoes, bread, rice, etc. The attempt was made to have the daily diet uniform through the whole time of the experiment, which extended over a period of 6 weeks. The nitrogen in the food was calculated by the compilers[1] from available data.[2] The nitrogen in the urine was determined by the Kjeldahl method. The specific gravity, reaction, sulphur, phosphorus, and chlorin were also determined. The nitrogen in the feces was supplied by the compilers from

[1] See note on page 110.

[2] U. S. Dept. Agr., Office of Experiment Stations Bul. 28.

Rutger's experiments (Nos. 447 and 448, Table 7) in which the diet was similar. The experiment was divided into five periods, and in the second and fourth periods urethan was added to the diet.

The following conclusions were reached: Urethan had a decided diuretic action, most noticeable on the second day after the drug was taken. Later the amount of urine excreted diminished as the dose of urethan was increased. The volume remained far below the average for 2 or 3 days after the drug had been discontinued; that is, until its elimination from the system was fairly complete. Urethan lowered the excretion of nitrogen, its effect being observed even when the dose was small—5 or 10 grains. After the drug was discontinued the nitrogen excretion rapidly became normal. The excretion of phosphorus was apparently increased by small doses of urethan. The excretion of sulphur was parallel with that of nitrogen. In no case was any hypnotic action observed.

Nos. 788–792 were made by Chittenden and Adams in 1888 (?) at the Laboratory of Physiological Chemistry at Yale University. The object was to study the influence of antipyrin on the metabolism of protein in a healthy organism. The subject was a man. The food consisted of meat, potatoes, bread, steamed oatmeal, milk, etc. The nitrogen in the food was computed by the compilers[1] in order that the experiment might be included in the present compilation. The uric acid in the urine was determined and also the urea by the Pflüger method. The reaction, specific gravity, chlorin, total phosphoric acid, and phosphoric acid combined with calcium and magnesia were also determined. From these data the amount of nitrogen in the urine was computed by the compilers. The nitrogen in the feces was taken by the compilers from Rutger's experiments (Nos. 447 and 448, Table 7) in which the diet was similar. The experiment was divided into five periods, and in the second and fourth antipyrin was given.

The conclusion was reached that antipyrin had a decided inhibitory action on the metabolism of protein in the healthy organism, as shown by the diminished excretion of urea and uric acid. It also tended to diminish the volume of urine. This was more marked when large doses were taken. No definite conclusion was drawn regarding the effect of antipyrin on the excretion of phosphoric acid and chlorin.

Nos. 793, 794 were made by Badt in von Noorden's laboratory at the Medical Institute of the University of Berlin in 1890. The object was to study the influence of phosphorus poisoning on metabolism. The subject was a woman 40 years old. She attempted suicide by drinking the water in which the ends of 3 boxes of matches had been dissolved. She died the day after the close of the experiment.

The food consisted of "Bolles Modified Milk," gruel, etc. Its composition was determined from actual analyses and from previous analyses by von Noorden. The nitrogen in the urine and the nitrogen and fat in the feces were determined. Qualitative analyses of the urine and blood were also made, and the experiment is discussed at length from a medical standpoint.

The principal conclusions reached were the following: In cases of phosphorus poisoning the decomposition of protein is enormously increased. However, when the poisoning causes death at once or during the final period of slow poisoning the nitrogen excretion becomes very small. In many cases the excretion of uric acid is not influenced, and in other cases it is influenced considerably. Small quantities of peptones, and probably leucin, and tyrosin were found in the urine in the above experiment, but not in such quantities that they influenced the nitrogen excretion. In cases of phosphorus poisoning the processes of oxidation are diminished, though this can not be determined with certainty from an examination of the nitrogen metabolism, but must rest upon the determination of oxygen consumption. Ten days after poisoning with phosphorus the intestine contained phosphorus and phosphoric acid in recognizable quantity.

Nos. 795–799 were made by Dronke and Ewald in the Empress Augusta Hospital in Berlin in 1891–92. The object was to study the effect of the continued use of

[1] See note on page 110.

Levico arsenic-iron water on metabolism. This mineral water, which is much used in Germany, comes from springs in the town of Levico in Austro-Hungary. There are two sorts, the "weak" and "strong." The weak contains in 10,000 grams 0.0095 gram arsenic acid (As_2O_3), 0.0003 gram sodium chlorid ($NaCl$), 6.7278 grams ferrous sulphate ($FeSO_4$), 2.7272 grams ferric sulphate ($Fe_2(SO_4)_3$), 1.5919 grams aluminum sulphate ($Al_2SO_4)_3$), 0.0520 gram copper sulphate ($CuSO_4$), as well as iron carbonate and sulphates of manganese, calcium, magnesium, potassium, sodium, ammonium, and silicon. The "strong" contains in 10,000 grams 0.086879 gram arsenic acid, 0.001781 gram sodium chlorid, 25.675198 grams ferrous sulphate, 13.019720 grams ferric sulphate, 6.239873 grams aluminum sulphate, 0.474459 gram copper sulphate, together with silicon, carbon from organic sources; and sulphates of manganese, calcium, magnesium, potassium, sodium, and ammonium. These springs have been known for more than 200 years and used for anæmia, lack of blood, scrofula, general weakness nervous troubles, skin diseases, etc.

Very little is known of the influence of the sulphates of iron on metabolism, and, so far as is known, no experiments have been made with man in which arsenic was given in small doses.

The subject of these experiments was a school-teacher. She was suffering from general weakness, nervousness, dyspepsia, and mental depression. An examination of the blood showed that there was no anæmia. This seemed a desirable case in which to try the Levico water. This experiment differs from most others with special medical treatment in that no tests were made when the remedial agent was not used. Such a comparison was not practicable in this case.

Three sorts of diet were followed: (1) Bouillon and milk; (2) bouillon, milk, meat, potatoes, eggs, and bread; (3) bouillon, milk, and a larger amount of bread, meat, eggs, etc.

The nitrogen in the urine, feces, and food, with the exception of eggs, vegetables, and preserved fruits, was determined. In these cases it was calculated from König's tables. Great care was observed in collecting the urine and feces. The separation was made by means of powdered charcoal.

Two teaspoonfuls of the Levico water was taken daily; for 8 days the "weak," and afterwards the "strong."

There was an interval of about two weeks between the second and third periods (Nos. 796, 799). The subject at first lost nitrogen, and then gained it steadily. She gained also 9 kilograms in weight. When the investigation was begun the number of red corpuscles in the blood was 5,120,000 per millimeter; at the end it was 8,400,000—a very large number. It might be thought that the improvement in the subject's health was due to better living, pleasanter surroundings, etc., during the experiment, and not to the mineral water. In the author's opinion this could hardly be the case, since her home was with a family who lived unusually well, and nothing which could contribute to her comfort was lacking. The article contains considerable discussion which is interesting from a medical standpoint.

Nos. 800–817 were made by Volkov and Stadnitski. The object was to study the influence of potassium iodid on the metabolism and assimilation of nitrogen and fat and on the variation in the amount of neutral sulphur in the urine of healthy subjects. The subjects were healthy persons between 22 and 24 years of age, servants in a military hospital. The food consisted of a simple mixed diet. The experiments lasted 12 days and were divided into three periods. During the second, the subjects were given 6 grams of potassium iodid in solution in 2 doses, one in the morning and one in the evening. The conditions were normal in the first and third periods. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The total sulphur and acid sulphur in the urine were determined and the difference between them was assumed to represent the amount of neutral sulphur. The fat of the feces was determined by Lachinov and Chernov's method.

The authors' conclusions were as follows: The assimilation of protein was very slightly lowered under the influence of potassium iodid, and the metabolism of nitrogen was increased. The processes of oxidation in the organism were diminished and

the quantities of nitrogen of incompletely oxidized products and of neutral sulphur in the urine were increased. Judging from the increase of sulphur in the urine the cleavage of protein in the tissues was increased. The quantity of urine was increased and the assimilation of fats very slightly diminished. The weight of the subjects was practically unchanged.

Nos. 818, 819. See Nos. 1858–1868, Table 18.

Nos. 820–850 were made by Jawein at the clinic of Professor Tschudnovski in St. Petersburg in 1891. The object was to study the influence of large doses of sodium bicarbonate and sodium citrate upon the metabolism of nitrogen in healthy individuals and upon the quantity of neutral sulphur and ether sulphuric acid in the urine. The subjects were healthy men.

The food was a simple mixed diet of bread, meat, etc. The nitrogen in the food, urine, and feces was determined. The total sulphur, total sulphuric acid, and ether sulphuric acid in the urine were also determined, and the neutral sulphur and preformed sulphuric acid calculated. In most cases the patients were in nitrogen equilibrium at the beginning of the experiment. The period in which sodium bicarbonate or sodium citrate was taken was preceded and in several cases followed by a four-day period with normal dietary conditions. When 20 grams of sodium bicarbonate was consumed it was taken in three portions between meals. The dose of 40 grams of sodium citrate was taken in the same way. The dose of 40 grams of sodium bicarbonate was taken in two portions. The urine was noticeably alkaline after taking 20 grams of sodium bicarbonate or 40 grams of sodium citrate. In all the experiments 12 hours after taking the alkali the urine had an acid reaction.

The conclusion is reached that large doses of either of the salts diminishes the assimilation of nitrogen, provided a laxative effect is produced. The nitrogen metabolism is little affected. Large doses of the salts cause a slight retention of water in the organism and do not increase the production of urine. They cause marked changes in metabolism as a whole, however, as is shown by the increase in the amount of neutral sulphur in the urine and the decrease of the acid sulphur. Apparently oxidation processes are retarded and fermentation in the intestines is unaffected.

Nos. 851–857 were made by Helmers in Berlin in 1883–84. The object was to study the effect of ichthyol upon metabolism. The investigator himself was the subject. The food, which consisted of a simple mixed diet, was prepared with great care, and, when possible, sufficient quantity of each article was procured to last through the whole experiment. The separation of the feces was made with berries or by the charcoal method. The nitrogen in food, urine, and feces was determined. The sulphur in urine and feces was also determined. The plan of the experiment was to give ichthyol-ammonium in water for a short period, preceded and followed by a normal period.

The following conclusions were reached: Ichthyol influences the metabolism of protein in the animal organism very slightly. So far as any influence can be observed it hinders decomposition of protein and increases its assimilation. Fully one-third of the sulphur contained in the ichthyol circulates in the fluids of the body and is eventually excreted in the urine. Part of that excreted in the feces apparently circulates in the body also and is exuded by the glands of the intestines.

EXPERIMENTS ON MUSCULAR EXERTION AND THE EXCRETION OF NITROGEN.

In Table 10 are included 183 tests with men in which the effect of muscular exertion on the excretion of nitrogen (urea) was studied. This question includes a discussion of the source of energy in the animal body, i. e., whether energy for internal and external work is furnished by the nitrogenous or nonnitrogenous constituents of the food. This is a much-disputed point, and the number of experiments on this subject is quite large. Experiments on this question with dogs will be found in Table 29 (Nos. 2455–2514).

TABLE 10.—*Experiments on muscular exertion and the excretion of nitrogen.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
858	1862–63	Parkes	Soldier (S.)	22	68.2	240 gm. arrowroot, 199.9 gm. sugar, 62.4 gm. butter.	2	0.0	8.2	0.4	— 8.6	Rest.
859	1862–63	....do	Soldier (T.)	38	51.9	191.4 gm. arrowroot, 148.4 gm. sugar, 42.2 gm. butter.	2	0.0	7.0	0.5	— 7.5	Do.
860	1862–63	....do	Soldier (S.)	22	68.2	398.3 gm. arrowroot, 210.8 gm. sugar, 94.3 gm. butter.	2	0.0	9.0	0.5	— 9.5	Work=167,566.5 kilogrammeters.
861	1862–63	....do	Soldier (T.)	38	51.9	293.4 gm. arrowroot, 180 gm. sugar, 63.8 gm. butter.	2	0.0	8.0	0.6	— 8.6	Work=127,585.0 kilogrammeters.
862	1863–64	Parkes	Soldier (S.)	22	......	Meat, bread, potatoes	4	19.6	17.9	1.2	+ 0.5	Ordinary occupation.
863	1863–64	....do	Soldier (B.)	22½	63.6	....do	4	19.6	18.5	0.6	+ 0.5	Do.
864	1863–64	....do	Soldier (S.)	22	......	....do	2	19.6	19.1	1.5	— 1.0	Rest.
865	1863–64	....do	Soldier (B.)	22½	......	....do	2	19.6	19.5	1.1	— 1.0	Do.
866	1863–64	....do	Soldier (S.)	22	......	....do	3	19.6	19.6	2.1	— 2.1	Work=16,199.8 kilogrammeters.
867	1863–64	....do	Soldier (B.)	22½	......	....do	3	19.6	20.0	1.5	— 1.9	Work=156.862.5 kilogrammeters.
868	1871	Flint	Professional pedestrian (Weston).	......	......	Meat, eggs, milk, bread, butter, potatoes, coffee, tea, head-cheese, etc.	5	22.0	18.7	1.4	+ 1.9	Before walk.
869	1871	....do	....do	......	......	Eggs, beef extract, oatmeal gruel, brandy, champagne.	5	13.2	21.6	1.6	—10.0	Subject walked 62 miles per day.
870	1871	....do	....do	......	......	Same as No. 868	5	28.6	22.0	2.2	+ 4.4	After walk.
871	1878	Jones	Professional pedestrian (Schmehl).	28	65.8	680 gm. beefsteak, 330 gm. egg, 1,420 gm. beef tea, porter, champagne, seltzer water.	4	28.6	25.0	1.4	+ 2.2	Subject walked 83⅓ miles per day.
872	1881	Oppenheim	Observer	21	52.2	400 gm. bread, 300 gm. meat, 950 cc. milk	2	18.9	16.0	1.2	+ 1.7	
873	1881	....do	....do	21	......	....do	1	18.9	16.5	1.2	+ 1.2	Urine passed every 2 hours.
874	1881	....do	....do	21	......	....do	1	18.9	16.2	1.2	+ 1.5	Urine passed every ½ hour.
875	1881	....do	....do	21	......	....do	1	18.9	16.7	0.9	+ 1.3	Urine passed every 2 hours.
876	1881	....do	....do	21	......	Fasting	1	0.0	16.2	0.9	—17.1	
877	1881	....do	....do	21	......	400 gm. bread, 300 gm. meat, 950 cc. milk	2	18.9	15.8	0.9	+ 2.2	Two days after No. 876.
878	1881	....do	....do	21	......	400 gm. bread, 300 gm. meat, 950 cc. milk, 4,000 cc. water.	1	18.9	18.5	1.2	— 0.8	Copious water drinking.
879	1881	....do	....do	21	......	400 gm. bread, 300 gm. meat, 950 cc. milk	3	18.9	15.5	1.1	+ 2.3	Three days after No. 878.
880	1881	....do	....do	21	......	....do	1	18.9	16.3	0.8	+ 1.8	Muscular work.

TABLE 10.—*Experiments on muscular exertion and the excretion of nitrogen*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. .	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
881	1881	Oppenheim	Observer	21	......	Meat, flour, vegetables, potatoes, condensed milk.	1	18.9	17.1	1.2	+ 0.6	Muscular work. Moderate dyspnœa.
882	1881	do	do	21	......	do	1	18.9	18.5	1.3	— 0.9	Muscular work. Severe dyspnœa.
883	1881	do	do	21	......	do	2	18.9	16.7	1.3	+ 0.9	Two days after No. 882.
884	1881	do	do	21	......	do	1	18.9	16.2	0.8	+ 1.9	Muscular work.
885	1881	do	do	21	......	do	1	18.9	15.8	0.8	+ 2.3	Day after No. 884.
886	1881	do	do	21	......	do	1	18.9	18.0	0.8	+ 0.1	Muscular work. Dyspnœa.
887	1881	do	do	21	......	do	1	18.9	16.7	0.8	+ 1.4	Day after No. 886.
888	1884	North	Observer	......	......	do	......	17.6	15.0	2.3	+ 0.3	P_2O_5 in food 3.9 gm., in urine 2.0 gm., in feces 2.2 gm., gain 0.2 gm.
889	1884	do	do	......	......	do	......	17.6	14.2	2.5	+ 0.9	Days of No. 888 before work, P_2O_5 in food 3.9 gm., in urine 2.0 gm., in feces 2.5 gm., loss 0.6 gm.
890	1884	do	do	......	......	do	......	17.6	15.7	2.2	— 0.3	Days of No. 888 after work, P_2O_5 in food 3.9 gm., in urine 2.0 gm., in feces 1.9 gm., gain or loss 0.0 gm.
891	1884	do	do	......	......	do	......	17.6	14.6	2.1	+ 0.9	P_2O_5 in food 3.9 gm., in urine 1.9 gm., in feces 2.0 gm., gain 0.1 gm.
892	1884	do	do	......	......	do	......	17.6	13.8	1.2	+ 2.6	Days of No. 891 before work, P_2O_5 in food 3.9 gm., in urine 2.0 gm., in feces 1.6 gm., gain 0.3 gm.
893	1884	do	do	......	......	do	......	17.6	15.3	2.7	— 0.4	Days of No. 891 after work, P_2O_5 in food 3.9 gm., in urine 1.8 gm., in feces 2.4 gm., loss 0.3 gm.

894	1884	....do	....do	......	......	....do	12	16.2	14.6	1.9	— 0.3	Period includes one day fasting. P_2O_5 in food 3.6 gm., in urine 1.8 gm., in feces 1.7 gm., gain 0.1 gm.
895	1884	....do	....do	......	......	....do	......	16.2	12.9	1.4	+ 1.9	Days of No. 894 before work, P_2O_5 in food 3.6 gm., in urine 1.8 gm., in feces 1.0 gm., gain 0.8 gm.
896	1884	....do	....do	......	......	....do	......	16.2	13.5	2.1	+ 0.6	Days of No. 894 after work, P_2O_5 in food 3.6 gm., in urine 1.5 gm., in feces 2.0 gm., gain 0.1 gm.
897	1884	....do	....do	......	......	....do	11	17.6	15.1	2.1	+ 0.4	Same as No. 894 with fasting day omitted in calculating results, P_2O_5 in food 3.9 gm., in urine 1.9 gm., in feces 1.9 gm., gain 0.1 gm.
898	1884	....do	....do	......	......	....do	......	17.6	13.2	1.8	+ 2.6	Days of No. 897 before work, P_2O_5 in food 3.9 gm., in urine 1.6 gm., in feces 1.6 gm., gain 0.4 gm.
899	1884	....do	....do	......	......	....do	......	17.6	18.3	2.4	— 3.1	Days of No. 897 after work, P_2O_5 in food 3.9 gm., in urine 2.4 gm., in feces 2.4 gm., loss 0.9 gm.
900	1885	Zasietski	Peasant (K.)	32	......	2,625 cc. milk	3	15.9	16.2	1.4	— 1.7	Rest.
901	1885	....do	....do	32	......	2,713 cc. milk	3	14.9	18.9	1.1	— 4.1	Walking.
902	1885	....do	Soldier (D.)	23	......	2,677 cc. milk	3	15.7	19.7	1.0	— 5.0	Do.
903	1885	....do	....do	23	......	2,623 cc. milk	3	15.8	18.9	0.9	— 4.0	Rest.
904	1885	....do	Peasant (M.)	40	......	3,987 cc. milk	3	21.9	17.0	1.3	+ 3.6	Do.
905	1885	....do	....do	40	......	3,730 cc. milk	3	21.2	18.0	1.3	+ 2.9	Walking.
906	1885	....do	Student (L.)	21	......	4,207 cc. milk	3	25.7	15.7	1.3	+ 8.7	Rest.
907	1885	....do	....do	21	......	4,300 cc. milk	3	25.9	16.8	1.2	+ 7.9	Walking.
908	1885	....do	Student (M.)	23	......	4,350 cc. milk	2	33.9	20.0	1.0	+12.9	Do.
909	1885	....do	....do	23	......	4,530 cc. milk	2	25.5	17.8	1.0	+ 6.7	Rest.
910	1885	....do	Student (B.)	24	......	1,350 cc. milk	2	7.0	11.7	0.4	— 5.1	Do.
911	1885	....do	....do	24	......	1,160 cc. milk	2	6.9	12.2	0.3	— 5.6	Walking.
912	1885	....do	Student (P.)	21	......	2,647 cc. milk	3	14.6	16.0	0.7	— 2.1	Do.
913	1885	....do	....do	21	......	3,167 cc. milk	3	17.9	14.3	0.7	+ 2.9	Rest.
914	1885	....do	Peasant (P.)	34	......	1,317 cc. milk	3	7.9	10.4	0.6	— 3.1	Do.
915	1885	....do	....do	34	......	1,067 cc. milk	3	6.5	11.3	0.4	— 5.2	Walking.
916	1885	....do	Student (Zh.)	21	......	2,350 cc. milk	2	13.4	12.1	0.9	+ 0.4	Rest.
917	1885	....do	....do	21	......	2,415 cc. milk	2	13.9	13.1	1.0	— 0.2	Walking.
918	1885	....do	Student (K.)	25	......	3,115 cc. milk	2	19.0	14.6	0.9	+ 3.5	Rest.
919	1885	....do	....do	25	......	3,190 cc. milk	2	19.5	15.6	1.0	+ 2.9	Walking.
920	1885	....do	Peasant (S.)	32	......	1,710 cc. milk	2	10.0	16.5	0.6	— 7.1	Do.
921	1885	....do	....do	32	......	1,600 cc. milk	2	9.8	15.4	0.6	— 6.2	Rest.

TABLE 10.—*Experiments on muscular exertion and the excretion of nitrogen*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
922	1885	Zasietski	Student (R.)	24		2,607 cc. milk	3	15.1	14.8	0.7	—0.4	Rest.
923	1885	do	do	24		2,666 cc. milk	3	15.3	16.1	0.6	—1.4	Walking.
924	1885	do	Peasant (K.)	40		1,717 cc. milk	3	10.3	13.7	0.6	—4.0	Rest.
925	1885	do	do	40		1,567 cc. milk	3	9.0	14.7	0.5	—6.2	Walking.
926	1885	do	Peasant (L.)	31		2,040 cc. milk	2	11.8	15.9	0.8	—4.9	Rest.
927	1885	do	do	31		2,230 cc. milk	2	13.4	17.2	0.9	—4.7	Walking.
928	1885	do	Peasant (M.)	21		3,305 cc. milk	2	19.9	15.1	1.9	+2.9	Rest.
929	1885	do	do	21		3,250 cc. milk	2	18.5	18.0	1.8	—1.3	Walking.
930	1888	Burlakov	Student (B.)		51.3	189 gm. meat, 478 gm. bread, 375 cc. milk, 1,200 cc. tea.	4	9.5	8.0	1.0	+0.5	Rest.
931	1888	do	do		51.4	187 gm. meat, 521 gm. bread, 269 cc. milk, 1,350 cc. tea.	4	8.2	8.4	0.7	—0.9	Work.
932	1888	do	do		51.4	201 gm. meat, 575 gm. bread, 413 cc. milk, 1,200 cc. tea.	4	9.5	7.1	0.9	+1.5	Rest.
933	1888	do	do		51.5	184 gm. meat, 611 gm. bread, 425 cc. milk, 1,300 cc. tea.	4	6.8	6.4	0.5	—0.1	Work.
934	1888	do	do		51.7	163 gm. meat, 671 gm. bread, 367 cc. milk, 1,200 cc. tea.	3	8.7	6.9	1.5	+0.3	Rest.
935	1888	do	Student (Yu.)		55.1	226 gm. meat, 436 gm. bread	4	6.6	10.1	1.3	—4.8	Do.
936	1888	do	do		55.2	295 gm. meat, 342 gm. bread	4	8.4	9.8	1.1	—1.5	Work.
937	1888	do	Student (I.)		60.2	220 gm. meat, 910 gm. bread, 750 gm. porridge, 1,250 cc. tea.	4	20.9	16.4	1.4	+3.1	Do.
938	1888	do	do		60.2	200 gm. meat, 950 gm. bread, 775 gm. porridge, 1,150 cc. tea.	4	20.0	14.9	2.1	+3.0	Rest.
939	1888	do	Student (B.)		50.4	287 gm. meat, 409 gm. bread, 585 gm. broth, 1,050 cc. tea.	4	21.3	11.9	1.1	+8.3	Do.
940	1888	do	do		50.4	230 gm. meat, 341 gm. bread, 530 gm. broth, 1,150 cc. tea.	4	19.9	13.5	1.5	+4.9	Work.
941	1889	Argutinsky	Observer		70.5	154 gm. meat, 302 gm. zwieback, 188 gm. condensed milk, water.	5	17.0	16.9	1.8	—1.7	
942	1889	do	do			200 gm. meat, 288 gm. bread, 137 gm. condensed milk, water.	3	16.5	18.2	1.5	—3.2	Work 1 day.
943	1889	do	do			200 gm. meat, 278 gm. bread, 137 gm. condensed milk, water.	3	16.5	16.1	1.5	—1.1	
944	1889	do	do			216.7 gm. meat, 88 gm. sugar, 71.6 gm. rice, 35 gm. butter, 27.5 gm. "avenicia," 158 gm. bread, water, beer, wine.	6	12.7	13.6	1.2	—2.1	

945	1889	....do	....do			250 gm. meat, 125 gm. sugar, 75 gm. rice, 20 gm. butter, 150 gm. bread, wine, beer, water.	3	12.7	17.0	1.2	—5.5	Do.
946	1889	....do	....do			....do	4	13.1	13.8	1.2	—1.9	
947	1889	....do	....do			250 gm. meat, 158 gm. sugar, 75 gm. rice, 20 gm. butter, 150 gm. bread, wine, beer, water.	3	13.4	14.9	1.1	—2.6	Do.
948	1889	....do	....do			Same as No. 945	4	12.6	12.8	0.9	—1.1	
949	1890	Hirschfeld	Observer	23	72.5	550 gm. meat, 170 gm. butter, 320 gm. bread, 300 gm. potato, 15 gm. sugar, 1,000 cc. beer (161.9 gm. protein, 167.0 gm. fat, 327 gm. carbohydrates, 30 gm. alcohol, 3,770 calories).	1	25.9	22.4	(2.3)	+1.2	
950	1890	....do	....do	23		....do	1	25.9	23.4	(2.3)	+0.2	
951	1890	....do	....do	23		....do	1	25.9	22.6	(2.3)	+1.0	Work.
952	1890	....do	....do	23		....do	1	25.9	22.8	(2.3)	+0.8	
953	1890	....do	....do	23		1,000 gm. potato, 180 gm. butter, 1,000 cc. beer, 100 gm. sugar, 50 gm. brandy, 80 gm. bread, 20 gm. coffee (37.2 gm. protein, 164 gm. fat, 408 gm. carbohydrates, 55 alcohol, 3,735 calories).	1	6.0	11.3	(2.3)	—7.6	
954	1890	....do	....do	23		....do	1	6.0	7.4	(2.3)	—3.7	
955	1890	....do	....do	23		....do	1	6.0	10.0	(2.3)	—6.3	Work.
956	1890	....do	....do	23		....do	1	6.0	7.2	(2.3)	—3.5	Do.
957	1890	....do	....do	23		800 gm. potato, 160 gm. bread, 160 gm. butter, 1,000 cc. beer, 50 gm. bacon, 20 gm. coffee, 250 cc. wine. 60 gm. sugar (42.6 gm. protein, 183.2 gm. fat, 378.5 gm. carbohydrates, 50 gm. alcohol, 3,780 calories).	1	6.8	10.0	(2.3)	—5.5	
958	1890	....do	....do	23		....do	1	6.8	7.5	(2.3)	—3.0	Do.
959	1890	....do	....do	23		....do	1	6.8	5.5	(2.2)	—0.9	
960	1890	Krummacher	Observer		68	300 gm. meat, 666.3 cc. milk, 100 gm. rice, 100 gm. bread, 500 cc. wine, 15 gm. pickled onions (102.4 gm. protein, 43.3 gm. fat, 230 gm. carbohydrates).	3	15.9	16.1	1.0	—1.2	Rest.
961	1890	....do	....do			....do	3	15.9	16.9	1.4	—2.4	Work (1 day).
962	1890	....do	....do			....do	2	15.9	15.3	0.8	—0.2	Rest.
963	1890	....do	....do			....do	4	15.9	17.0	1.1	—2.2	Work (2 days).
964	1890	....do	....do			....do	2	15.9	15.3	1.2	—1.6	Rest.
965	1891	Paton	Medical student	30	61.4	250 cc. soup, 100 gm. oatmeal gruel, 500 gm. oatmeal biscuit, 6 gm. cocoa, 40 gm. butter, 50 gm. sugar, 160 gm. rice, 130 gm. figs, 60 cc. condensed milk (153.2 gm. fat, 523 gm. carbohydrates, 3,978.8 calories).	5	16.1	11.1	4.9	+0.1	Do.
966	1891	....do	....do	30		....do	4	16.1	11.3	3.7	+1.1	Last 4 days of No. 965.
967	1891	....do	....do	30		....do	1	16.1	10.6	1.8	+3.7	Work=16,270 kilogram meters.
968	1891	....do	....do	30		....do	3	16.1	12.7	3.6	—0.2	3 days after No. 967.
969	1891	....do	....do	30		....do	4	16.1	12.2	3.2	+0.7	
970	1894	Punine	Cavalry soldier (M.)	21	69.5	966 gm. black bread, 1,031 gm. milk, 178 gm. meat. 400 gm. blueberry soup (1 day).	5	20.8	17.2	5.2	—1.6	Rest.
971	1894	....do	....do	21	69.0	900 gm. black bread, 747 gm. milk, 130 gm. meat, 120 gm. manna gruel, 356 gm. broth, 200 gm. blueberry soup (1 day).	5	16.2	13.3	5.1	—2.2	Riding.

TABLE 10.—*Experiments on muscular exertion and the excretion of nitrogen*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
972	1894	Punine	Foot soldier (L.)	21	69.0	966 gm. black bread, 1,031 gm. milk, 178 gm. meat, 400 gm. blueberry soup (1 day).	5	20.9	17.0	5.7	—1.8	Rest.
973	1894	do	do	21	68.5	900 gm. black bread, 747 gm. milk, 150 gm. meat, 120 gm. manna gruel, 356 gm. broth (1 day), 200 gm. blueberry soup.	5	16.2	16.9	3.6	—4.3	Riding.
974	1894	do	Cavalry soldier (R.)	21	60.2	910 gm. black bread, 481 gm. milk, 106 gm. meat, 140 gm. manna gruel, 276 gm. broth (1 day), 200 gm. blueberry soup.	5	17.6	14.3	3.5	—0.2	Rest.
975	1894	do	do	21	60.2	900 gm. black bread, 412 gm. milk, 219 gm. meat, 345 gm. broth (1 day), 200 gm. blueberry soup.	5	20.4	17.1	4.1	—0.8	Riding.
976	1894	do	Cavalry soldier (L.)	21	71.5	878 gm. black bread, 425 gm. milk, 106 gm. meat, 146 gm. manna gruel, 276 gm. broth, 200 gm. blueberry soup.	5	16.9	9.3	3.7	+3.9	Rest.
977	1894	do	do	21	70.0	900 gm. black bread, 412 gm. milk, 219 gm. meat, 345 gm. broth, 200 gm. blueberry soup.	5	20.4	17.0	4.6	—1.2	Riding.
978	1894	do	Foot soldier (Sh.)	21	68.5	910 gm. black bread, 481 gm. milk, 106 gm. meat, 276 gm. broth, 100 gm. manna gruel, 200 gm. blueberry soup.	5	17.6	14.4	4.3	—1.1	Rest.
979	1894	do	do	21	88.1	900 gm. black bread, 412 gm. milk, 219 gm. meat, 345 gm. broth, 200 gm. blueberry soup.	5	20.4	17.2	3.3	—0.1	Riding.
980	1894	do	Cavalry soldier (Sh.)	21	71.2	660 gm. white bread (1 day), 634 gm. black bread, 156 gm. meat, 228 gm. manna gruel, 540 gm. soup, 200 gm. blueberry soup.	5	15.4	15.6	2.8	—3.0	Rest.
981	1894	do	do	21	71.2	815 gm. white bread (1 day), 702 gm. black bread, 134 gm. meat, 210 gm. manna gruel, 425 gm. soup, 200 gm. blueberry soup.	5	16.3	15.9	2.9	—2.5	Riding.
982	1894	do	Cavalry soldier (U.)	21	74.1	660 gm. white bread (1 day), 634 gm. black bread, 156 gm. meat, 228 gm. manna gruel, 540 gm. soup, 200 gm. blueberry soup.	5	15.4	15.5	3.2	—3.3	Rest.
983	1894	do	do	21	73.8	815 gm. white bread (1 day), 702 gm. black bread, 134 gm. meat, 210 gm. manna gruel, 425 gm. soup, 200 gm. blueberry soup.	5	16.2	15.0	4.5	—3.3	Riding.
984	1894	do	Foot soldier (Ba.)	21	71.3	600 gm. white bread (1 day), 634 gm. black bread, 156 gm. meat, 228 gm. manna gruel, 540 gm. soup, 200 gm. blueberry soup.	5	15.4	15.1	2.5	—2.2	Rest.

985	1894	.....do	.....do	21	70.8	815 gm. white bread (1 day), 540 gm. black bread, 82 gm. meat, 210 gm. manna gruel, 402 gm. soup.	5	12.8	13.9	1.8	—2.9	Riding.
986	1894	.....do	Cavalry soldier (E.).	25	61.3	543 gm. black bread, 123 gm. white bread, 140 gm. meat, 360 gm. buckwheat, 828 gm. sour cabbage soup, 161 gm. kvass, 150 gm. blueberry soup.	5	21.1	15.5	5.2	+0.4	Do.
987	1894	.....do	.....do	25	61.1	453 gm. black bread, 150 gm. white bread, 132 gm. meat, 238 gm. buckwheat, 1,035 gm. sour cabbage soup, 200 gm. blueberry soup (1 day).	5	18.5	14.0	3.5	+1.0	Rest.
988	1894	.....do	Foot soldier (Mn.) ..	25	67.7	643 gm. black bread, 140 gm. white bread, 140 gm. meat, 380 gm. buckwheat, 828 gm. sour cabbage soup, 808 gm. kvass, 150 gm. blueberry soup (1 day).	5	22.8	17.1	4.4	+1.3	Riding
989	1894	.....do	.....do	25	68.0	530 gm. black bread, 150 gm. white bread, 132 gm. meat, 260 gm. buckwheat, 1,035 gm. sour cabbage soup, 200 gm. blueberry soup (1 day)	5	19.7	13.8	2.5	+3.4	Rest.
990	1894	.....do	Foot soldier (In.) ...	25	69.4	495 gm. black bread, 140 gm. white bread, 140 gm. meat, 312 gm. buckwheat, 828 gm. sour cabbage soup. 161 gm. kvass, 100 gm. blueberry soup (1 day).	5	20.1	16.0	1.9	+2.2	Riding.
991	1894	.....do	.....do	25	69.2	498 gm. black bread, 150 gm. white bread, 132 gm. meat, 260 gm. buckwheat, 1,035 gm. sour cabbage soup, 200 gm. blueberry soup (1 day).	5	19.3	13.7	2.9	+2.7	Rest.
992	1894	.....do	Cavalry soldier (O.).	25	73.0	740 gm. black bread, 200 gm. white bread, 100 gm. meat, 400 gm. buckwheat, 621 gm. sour cabbage soup, 414 gm. pea soup, 200 gm. blueberry soup (1 day).	5	23.9	12.9	7.4	+3.6	Riding.
993	1894	.....do	.....do	25	73.0	750 gm. black bread, 140 gm. white bread, 110 gm. meat, 370 gm. buckwheat, 759 gm. sour cabbage soup, 276 gm. pea soup, 150 gm. blueberry soup (1 day).	5	21.4	12.3	5.0	+4.1	Rest.
994	1894	.....do	Cavalry soldier (Ts.)	25	69.1	750 gm. black bread, 200 gm. white bread, 100 gm. meat, 400 gm. buckwheat, 621 gm. sour cabbage soup, 414 gm. pea soup, 200 gm. blueberry soup (1 day).	5	23.9	14.6	6.3	+3.0	Riding.
995	1894	.....do	.....do	25	70.0	750 gm. black bread, 140 gm. white bread, 110 gm. meat, 759 gm. sour cabbage soup, 370 gm. buckwheat, 276 gm. pea soup, 100 gm. blueberry soup (1 day).	5	21.4	15.9	5.7	—0.2	Rest.
996	1894	.....do	Cavalry soldier (P.).	25	78.5	740 gm. black bread, 200 gm. white bread, 100 gm. meat, 400 gm. buckwheat, 621 gm. sour cabbage soup, 414 gm. pea soup, 200 gm. blueberry soup (1 day).	5	23.9	16.5	4.9	+2.5	Riding.

TABLE 10.—*Experiments on muscular exertion and the excretion of nitrogen*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
997	1894	Punine	Cavalry soldier (P.).	25	78.7	750 gm. black bread, 140 gm. white bread, 110 gm. meat, 370 gm. buckwheat, 759 gm. sour cabbage soup, 276 gm. pea soup, 150 gm. blueberry soup (1 day).	5	21.4	17.1	3.8	+0.5	Rest
998	1894	....do	Foot soldier (D.)	25	77.5	740 gm. black bread, 200 gm. white bread, 99 gm. meat, 400 gm. buckwheat, 621 gm. sour cabbage soup, 414 gm. pea soup, 200 gm. blueberry soup (1 day).	5	23.8	15.1	4.4	+4.3	Riding.
999	1894	....do	....do	25	77.2	750 gm. black bread, 140 gm. white bread, 110 gm. meat, 370 gm. buckwheat, 759 gm. sour cabbage soup, 276 gm. pea soup, 150 gm. blueberry soup (1 day).	5	21.4	16.8	4.4	+0.2	Rest.
1000	1896	Krummacher	Observer		64	200 cc. milk, 150 gm. rice, 200 gm. zwieback, 300 gm. lean beef, 81 gm. butter, 20 gm. milk sugar, 15 gm. onion, 500 cc. wine (95.3 gm. protein, 88.2 gm. fat, 303.2 carbohydrates, 2,459 calories).	4	15.3	15.1	1.4	—1.2	Do.
1001	1896	....do	....do		64	....do	1	15.6	16.4	1.4	—2.2	Work=153,070 kilogrammeters (359,590 calories).
1002	1896	....do	....do		64	....do	1	15.6	17.5	1.4	—3.3	Rest. Next day after No. 1001.
1003	1896	....do	....do		64			15.6	17.0	1.4	—2.8	Average of Nos. 1000, 1001.
1004	1896	....do	....do		64	As in No. 1000	2	15.6	15.4	1.4	—1.2	Rest. Two days following No. 1002.
1005	1896	....do	Laboratory servant.		79	400 gm. rice, 300 gm. meat, 200 gm. zwieback, 200 cc. milk, 1,955.6 cc. beer (21.9 gm. protein, 167.6 gm. fat, 709.1 carbohydrates, 5,034 calories).	4	21.9	18.0	2.7	+1.2	Rest.
1006	1896	....do	....do		79	....do	1	21.9	17.2	2.7	+2.0	Work=324,540 kilogrammeters (762,700 calories).
1007	1896	....do	....do		79	....do	2	21.9	18.6	2.7	+0.6	Rest. Two days following No. 1006.
1008	1896	....do	....do		79			21.9	18.1	2.7	+1.1	Average of Nos. 1005 and 1006.

1009	1896	....do	....do		79	As in No. 1005	1	21.9	16.4	2.7	+2.8	Rest. Third day following No. 1005.
1010	1896	....do	Laboratory servant.		72	700 gm. rice, 300 gm. zwieback, 200 gm. butter, 1,932.4 cc. beer (89.3 gm. protein, 175.1 gm. fat, 902.6 carbohydrates, 5,701 calories).	1	14.3	12.3	3.0	+1.0	Rest. Fourth day before No. 1012.
1011	1896	....do	....do		72	....do	3	14.3	10.7	3.0	+0.6	Rest. First to third day before No. 1012.
1012	1896	....do	....do		72	....do	1	14.3	11.0	3.0	+0.3	Work=401,965 kilogram-meters (944,700 calories).
1013	1896	....do	....do		72	....do	3	14.3	10.7	3.0	+0.6	Rest. Three days following No. 1012.
1014	1892	Zavadovski	Hospital servant (R.)	24	57	800 gm. bread, 300 gm. meat, 780 cc. milk, 50 gm. butter, 80 gm. sugar, 1,600 cc. tea and water.	5	27.1	20.1	2.3	+4.7	
1015	1892	....do	....do	24	57	....do	5	25.9	21.0	2.9	+2.0	Breathing exercise.
1016	1892	....do	....do	24	58	....do	5	27.5	23.7	1.8	+2.0	
1017	1892	....do	Hospital servant (P.)	23	59	....do	5	27.1	18.4	2.6	+6.1	
1018	1892	....do	....do	23	60	....do	5	26.0	20.2	2.0	+3.8	Do.
1019	1892	....do	....do	23	60	....do	5	27.5	20.8	2.6	+4.1	
1020	1892	....do	Hospital servant (N.)	24	52	740 gm. bread, 300 gm. meat, 780 cc. milk, 50 gm. butter, 80 gm. sugar, 1,600 cc. tea and water.	5	26.0	17.8	2.4	+5.8	
1021	1892	....do	....do	24	53	As in No. 1014	5	26.0	20.4	1.5	+4.1	Do.
1022	1892	....do	....do	24	53	....do	5	27.5	22.3	2.8	+2.4	
1023	1892	....do	Hospital servant (V.)	23	64	....do	5	27.1	19.3	3.1	+4.7	
1024	1892	....do	....do	23	64	....do	5	26.0	23.6	2.7	—0.3	Do.
1025	1892	....do	....do	23	64	....do	5	27.5	20.2	2.5	+4.8	
1026	1892	....do	Hospital servant (M.)	23	60	....do	5	27.1	19.2	2.3	+5.6	
1027	1892	....do	....do	23	60	....do	5	26.0	22.6	2.0	+1.4	Do.
1028	1892	....do	....do	23	59	....do	5	27.6	20.8	1.9	+4.9	
1029	1892	....do	Nurse (Ch.)	22	61	600 gm. bread, 250 gm. meat, 1,000 cc. milk, 60 gm. butter, 70 gm. sugar, 1,400 cc. tea and water.	5	22.7	18.9	1.2	+2.6	
1030	1892	....do	....do	22	62	....do	5	21.9	16.9	1.2	+3.8	Do.
1031	1892	....do	....do	22	63	....do	5	21.5	17.8	1.3	+2.4	
1032	1892	....do	Hospital servant (V.)	24	64	800 gm. bread, 250 gm. meat, 1,000 cc. milk, 60 gm. butter, 70 gm. sugar, 1,400 cc. tea and water.	5	26.6	23.6	2.6	+0.4	
1033	1892	....do	....do	24	64	....do	5	24.6	24.6	2.5	—2.5	Do.
1034	1892	....do	....do	24	64	....do	5	24.3	22.9	2.3	—0.9	
1035	1892	....do	Hospital servant (P.)	24	60	750 gm. bread, 250 gm. meat, 1,000 cc. milk, 60 gm. butter, 70 gm. sugar, 1,400 cc. tea and water.	5	24.0	22.5	1.9	—0.4	
1036	1892	....do	....do	24	60	....do	5	23.6	19.6	1.5	+2.5	Do.
1037	1892	....do	....do	24	60	....do	5	24.0	14.8	1.8	+7.4	

TABLE 10.—*Experiments on muscular exertion and the excretion of nitrogen*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (−).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1038	1892	Zavadovski	Hospital servant (S.)	24	60	750 gm. bread, 250 gm. meat, 1,000 cc. milk, 60 gm. butter, 70 gm. sugar, 1,400 cc. tea and water.	5	24.0	19.7	2.3	+2.0	
1039	1892	do	do	24	61	As in No. 1035	5	23.6	17.4	1.8	+4.4	Breathing exercise.
1040	1892	do	do	24	61	do	5	23.8	16.4	1.7	+5.7	

Nos. 858, 859. Proc. Roy. Soc. London, 15, p. 343. Nos. 860, 861. Ibid., p. 346. Nos. 862, 863. Proc. Roy. Soc. London, 16, p. 45. Nos. 864–867. Ibid., p. 48. No. 868. New York Med. Jour., 13, p. 653. No. 869. Ibid., p. 655. No. 870. Ibid., p. 657. No. 871. New Orleans Med. and Surg. Jour., 5, 1877–78, pp. 856–858. Nos. 872–887. Pflüger's Arch. ges. Physiol., 23, p. 497. Nos. 888–890. Proc. Roy. Soc. London, 36, p. 14. Nos. 891–894. Ibid., p. 15. Nos. 895, 896. Ibid., p. 16. No. 897. Ibid., p. 15. Nos. 898, 899. Ibid., p. 16. Nos. 900–909. Vrach, 6, p. 866. Nos. 910–921. Ibid., p. 887. Nos. 922–929. Ibid., p. 888. Nos. 930–934. Influence of muscular work on the assimilation and metabolism of nitrogen. Vrach, 9, p. 66. Nos. 935–940. Ibid., p. 67. Nos. 941–948. Pflüger's Arch. ges. Physiol., 46, p. 579. Nos. 949–952. Virchow's Archiv. path. Anat. und Physiol., 121, p. 504. Nos. 953–956. Ibid., p. 506. Nos. 957–959. Ibid., p. 508. Nos. 960–964. Pflüger's Arch. ges. Physiol., 47, p. 457. Nos. 965–969. Rept. Lab. Roy. Col. Physicians (Edinburgh), 3, p. 247. Nos. 970, 971. The influence of horseback riding on the metabolism and assimilation of nitrogen in healtby men. Inaug. Diss. (Russian), St. Petersburg, 1894, Table 1. Nos. 972, 973. Ibid., Table 2. Nos. 974, 975. Ibid., Table 3. Nos. 976, 977. Ibid., Table 4. Nos. 978, 979. Ibid., Table 5. Nos. 980, 981. Ibid., Table 6. Nos. 982, 983. Ibid., Table 7. Nos. 984, 985. Ibid., Table 8. Nos. 986, 987. Ibid., Table 9. Nos. 988, 989. Ibid., Table 10. Nos. 990, 991. Ibid., Table 11. Nos. 992, 993. Ibid., Table 12. Nos. 994, 995. Ibid., Table 13. Nos. 996, 997. Ibid., Table 14. Nos. 998, 999. Ibid., Table 15. Nos. 1000–1004. Ztschr. Biol., 33, p. 119. Nos. 1005–1009. Ibid., p. 123. Nos. 1010–1013. Ibid., p. 125. Nos. 1014–1016. The influence of a special breathing exercise (deep inspiration and slow expiration) on the metabolism and assimilation of nitrogen in healthy subjects. Inaug. Diss. (Russian), St. Petersburg, 1892, p. 39. Nos. 1017–1019. Ibid., p. 40. Nos. 1020–1022. Ibid., p. 41. Nos. 1023–1025. Ibid., p. 42. Nos. 1026–1028. Ibid., p. 43. Nos. 1029–1031. Ibid., p. 44. Nos. 1032–1034. Ibid., p. 45. Nos. 1035–1037. Ibid., p. 46. Nos. 1038–1040. Ibid., p. 47.

Nos. 858–861 were made by Parkes in 1861. The object was to investigate the excretion of nitrogen by the kidneys and intestines during rest and exercise when the diet contains no nitrogen. The subjects were two healthy soldiers about 6 feet tall doing duty at the Royal Victoria Hospital at Netley. A diet of starch, sugar, and butter was consumed. The work done consisted of walking on level ground; the amount was calculated from Houghton's formula, that when walking on a level the work is equal to that of lifting one-twentieth of the weight through the distance walked. Several other experiments were made with a mixed diet, but the food was not analyzed. The urea in the urine was determined by the Liebig method and the nitrogen in urine and feces by the soda-lime method.

It was found that when the diet contained no nitrogen, exercise did not materially increase the nitrogen excreted in the urine or feces. The amount of urea excreted during work was less than during rest. The men were exhausted after a small amount of work was performed.

The conclusion is reached that although work can be done on a nonnitrogenous diet, it does not follow that nitrogen is unnecessary. It is more probable that the organism used some of its own nitrogen during this short period. Experience shows that nitrogen must be supplied when work is done and that the amount must increase with the work.

Nos. 862–867 were made by Parkes in 1862, and are a continuation of Nos. 858–861. The object was to study the elimination of nitrogen during rest and exercise with a regulated consumption of nitrogen. The subjects were two soldiers doing duty in the Royal Victoria Hospital at Netley. Subject S. was the same as in Nos. 858 and 860. The food was a simple mixed diet consisting of bread, meat, potatoes, etc. The nitrogen in the bread was determined. The bread was always made in the same way. In the other articles the nitrogen was calculated. Neither alcohol nor tobacco was used. The nitrogen in the urine and feces and the urea in the urine were determined as in Nos. 858–861. The work performed consisted in walking over level ground, the amount being computed as before. A period at ordinary occupation on the same diet preceded and followed Nos. 866, 867, but the feces were not analyzed. Subject S. excreted in the urine 16.6 grams and 21.1 grams of nitrogen, and Subject B. excreted 18.5 and 20.1 grams.

The following conclusions were reached: The nitrogen consumed remaining the same, the amount excreted during rest was a little greater than during ordinary occupation; during active exercise the amount of urinary nitrogen decreased; after exercise there was a small but long-continued excess in the excretion of nitrogen, and after both rest and exercise there was a retention of nitrogen in the system, when it was again supplied after having been cut off.

Nos. 868–870 were made by Flint and associates in New York in 1870. The object was to investigate the relation of the excretion of urea to exercise. The subject was the professional pedestrian, Weston, who endeavored to walk 400 miles in 5 consecutive days and on 1 day to cover 112 miles. This he was unable to do. The total distance walked was 317 miles, the greatest distance on 1 day being 92 miles. For 5 days before and after the walk and during that time the subject was carefully watched. All the food consumed and all the excreta were weighed.

In Nos. 868 and 870 the food was a very abundant mixed diet consisting of meat, bread, milk, eggs, etc. In No. 869 the food consisted of beef extract, oatmeal gruel, raw eggs, and a little brandy and champagne. The nitrogen in oatmeal gruel, head cheese, and beef extract was determined; in other articles of food it was computed from Payen's figures. The urea, uric acid, phosphoric acid, and sulphuric acid in the urine and the nitrogen in the feces were determined. The subject was thoroughly exhausted by the severe exercise, but recovered quickly and experienced no bad after effects.

The conclusion is reached that severe muscular exertion increases the excretion of urea very considerably.

No. 871 was made by Jones in New Orleans in 1878. The object was to investigate the effect of prolonged muscular exertion upon the excretion of urine, urea, uric acid, phosphoric acid, sulphuric acid, and sodium chlorid. The subject was Schmehl, the professional pedestrian. The muscular exertion consisted in walking 500 miles in 142 hours, 17 minutes, and 5 seconds. The aggregate time consumed in walking was about 95½ hours and in rest about 47 hours. The average time required for each mile walked was 11½ minutes. The average distance covered each day was 83⅓ miles. The prolonged exertion produced no bad after effects. The food consumed consisted of rare beefsteak, beef tea, and eggs. Porter, champagne, and seltzer water were used as beverages.

The urea, uric, phosphoric, and sulphuric acids, and sodium chlorid in the urine were determined. The author did not determine the nitrogen in the food, urine, or feces. In order that the experiment might be included in the present compilation, the nitrogen in the food was calculated from the standard table of analyses of American food materials and the nitrogen in the feces was taken from experiment No. 868, where the diet was somewhat similar. The nitrogen in the urine was calculated from the amount of urea and uric acid. The urea and uric acid excretion diminished gradually during the experiment. On the first day it was 62.9 grams and 0.6 gram, respectively, and on the last day 39.0 grams and 0.5 gram.

The author compared his results with those obtained with individuals under normal conditions. The conclusion was reached that increased muscular exertion increased the excretion of urea and phosphoric and sulphuric acids.

Nos. 872–887 and Nos. 607–613 were made by Oppenheim in the laboratory of the Institute of Animal Physiology at Poppelsdorf, near Bonn, in 1879–80. The object was to study the physiology and pathology of the excretion of urea. The author himself was the subject. The food consisted of bread, meat, and milk. The nitrogen in the food was determined every 3 days. The nitrogen in the feces and the urea in the urine were determined.

The following special questions were investigated:

(1) The influence of frequent urination on the excretion of urea (Nos. 873–875). The effect was so slight that no general conclusion could be drawn from the few experiments.

(2) The excretion of urea when fasting is begun (Nos. 876, 877). The excretion of urea was immediately diminished. This is in accord with the views of Bischoff, Voit, and others.

(3) The influence of the consumption of large quantities of water (Nos. 878, 879). The conclusion was reached that the urine and urea excretions are both increased. The extra quantity of water consumed was 4 liters, and the urine was increased 3 liters.

(4) The influence of coffee (see Nos. 607, 608, Table 9). The amount of urine excreted was increased, but the urea excretion diminished. The feces contained a larger amount of nitrogen than usual, and in the 2 days following the test there was no feces. No conclusion is drawn from these results. The subject had been without coffee or tea for a long time, and the coffee had a marked intoxicating effect.

(5) The effect of quinin (see Nos. 609, 610, 613, Table 9). The quinin had an intoxicating effect. The excretion of urine was not much more than normal, while the urea excretion was increased, this effect being produced in the first 8 hours after taking the quinin.

(6) The effect of perspiring when the loss of moisture is made good by an increased consumption of water (see Nos. 611, 612, Table 9). The increased perspiration was brought about by a hypodermic injection of pilocarpin. As much extra water was consumed as would satisfy thirst, viz, 500 cubic centimeters. The perspiration was not very great, although the subject remained in bed. An increased secretion of saliva was observed, which began a very few minutes after the injection. There was an increased secretion of tears and tracheal, or bronchial, discharges. No marked effect on the urea excretion was observed.

(7) The effect of muscular exertion on the metabolism of protein (Nos. 880–887). The exertion consisted in climbing a hill several times. When this was done so rapidly that the subject was out of breath, i. e., severe labor was performed, the excretion of urea was increased. In the first experiment, where there was no severe work, it was not increased. The normal days between the experiments are also included in the table. On these days the nitrogen excretion remained quite constant.

In the pathological experiments no details or analyses of food or feces are given.

In general, the experiments bear out the conclusions of other observers.

Nos. 888–899 were made by North in 1882. The object was to study the effect of physical labor on the elimination of nitrogen. The investigator himself was the subject. The food consisted of meat dried and ground to a powder, flour, dried vegtables, potatoes (Edwards' patent desiccated), and condensed milk. It was believed that with these articles a perfectly uniform diet could be prepared. The nitrogen and phosphoric acid in the food, urine, and feces were determined.

The diet was followed for 4 or 5 days before the experiments begun, in order to eliminate any nitrogen due to a previous diet. In No. 894 a fast of 24 hours was also included, in order to more nearly accomplish this end. Thus there are 2 sets of values in the table, the figures in Nos. 894–896 including the day of fasting, and those in Nos. 897–899 representing the same period, omitting the day of fasting. In all the experiments the time was 9 to 12 days. At the middle of the period a definite amount of muscular work was performed, consisting of walking a known distance (30 to 47 miles) and carrying a known load (about 27 pounds).

The conclusions reached agree in general with those of Parkes (Nos. 855–867), but it was believed that the effect of severe labor on the nitrogen excretion is more immediate and more pronounced than Parkes's experiments show. The labor performed in his experiments was not sufficiently severe.

The author believed that the storing up of nitrogen in the organism is the "expression of a tendency to economize resources." Unless the labor be very severe the excretion of phosphates is not increased.

Nos. 900–929 were made by Zasietski at the University of St. Petersburg in 1885. The object was to investigate the influence of muscular work on the metabolism of nitrogen. Fifteen experiments are described. The subjects were healthy persons. In most of the experiments a period of 2 or 3 days of absolute rest (lying down) was followed by several days of severe muscular exertion, which consisted of walking from 9 a. m. to 9 p. m., with short intervals of rest. In several experiments the periods were reversed. Milk was the only food consumed. The nitrogen of the food, urine, and feces was determined by the Seegan method.

The following conclusions were reached: In increased muscular exertion the nitrogen metabolism was increased 4 to 18 per cent, or, on an average, 9 per cent. In 10 of the 15 tests the quantity of urine increased, on an average, 210 cubic centimeters daily. Increased muscular exertion did not exercise a definite influence on the assimilation of protein. In 10 cases the assimilation increased, on an average, 6.4 per cent; in 4 cases it decreased 0.5 per cent, and in 1 case it remained unchanged. The muscular exertion did not exercise a definite influence upon the amount of milk consumed in the above experiments.

Nos. 930–940 were made by Burlakov in St. Petersburg in 1888. The object was to investigate the influence of muscular work on the metabolism and assimilation of nitrogen. Five experiments are described. Each experiment included a preliminary period (2 to 3 days), a period of rest (4 days), and a period of work (4 days). Some of the experiments began with rest and ended with work, and in others the conditions were reversed. The work consisted of (1) wood chopping; (2) carrying heavy loads of water, wood, and the like; (3) gymnastics (exercises with 10 to 15 pound dumb-bells), and (4) more or less extended walks. The work was performed several hours each day. The food consisted of a simple mixed diet.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author sums up his results as follows: Under the influence of moderate muscular work assimilation of nitrogenous substances increased from 1.2 to 8.7 per cent, or, on an average, 5.02 per cent. This increase of assimilation was maintained also during the period of rest following the period of work. The assimilation was diminished at first during intensified work, when the subjects were unaccustomed to it.

Under the influence of muscular exertion the metabolism of nitrogen generally increased from 1.1 to 18.5 per cent, or, on an average, 12.2 per cent. There was no marked influence on the weight of the body.

Nos. 941–948 were made by Argutinsky in the laboratory of the Physiological Institute in Bonn in 1889 (?). The object was to investigate the influence of muscular exertion on nitrogen metabolism. The investigator himself was the subject. Some time before the experiment he had observed that for several days after a long walk the nitrogen in the urine was increased. These experiments were therefore undertaken to investigate the matter. The food was most carefully prepared. It consisted of bread (zwieback), meat, and condensed milk. In some cases rice, butter, sugar, and "avenicia" (a sort of oatmeal) were consumed also. The nitrogen was determined by the Kjeldahl method in food, urine, and feces. The meat (beef) was freed from all visible fat, chopped and mixed. Samples were taken for analyses. The muscular exertion which was performed in these experiments consisted of long walks and mountain climbing. In No. 942 the distance covered was 18 to 20 kilometers, and the height climbed was 1,300 meters. In No. 945 the distance walked was 18 to 20 kilometers, and the height climbed 1,600 meters. In No. 947 the distance walked was about 12 kilometers, and the height climbed 1,300 meters. The exercise increased the amount of nitrogen in the urine, and the effect was observed for 2 days after the exercise. The author attributes this effect to the climbing, and not to the long walk. In No. 947 a large quantity of sugar was consumed. This did not prevent the increased metabolism of nitrogen, although it was calculated that the amount of sugar consumed was twice as great as was required to furnish the necessary energy for the climbing. Further, the conclusion was reached that the extra amount of protein metabolized when the climbing was done (as indicated by the increased amount of nitrogen in the urine) would account for 75 to 100 per cent of the energy actually expended.

These experiments are considered to be additional proofs of Pflüger's theory that protein is the source of muscular energy.

[The author left out of account the energy which is required for walking, i. e., "forward progression." This was pointed out by Paton (Nos. 965–969). An extended criticism of Argutinsky's work was made by Munk.[1] His conclusion is that the results do not disprove the theory that energy is chiefly produced by the metabolism of the nitrogen-free substances, and it is only when from some cause these are not furnished that the protein is metabolized. Some of Argutinsky's other assumptions are, according to Munk, not warranted. Thus, the extra amount of sugar consumed in No. 947 is not half sufficient to account for the energy of the exercise, including forward progression.]

Nos. 949–959 were made by Hirschfeld at the chemical laboratory of the Physiological Institute of the University of Würzburg in 1887. The object was to investigate the influence of increased muscular exertion upon the metabolism of protein. Three experiments are described. The author himself was the subject. His food consisted of a mixed diet of meat, bread, butter, potatoes, etc. The nitrogen in the food, urine, and feces was determined by the Kjeldahl method. In the first experiment (Nos. 949–952) the diet was rich in protein, and in the second and third experiments (Nos. 953–959) the amount of protein was small. On 1 or 2 days of each experiment the subject took a rapid walk, which included climbing a hill 400 to 500 meters high. By this severe muscular exertion the pulse was increased to 80 and the

[1] Pflüger's Arch., 46 (1890), p. 563.

respiration to 48. On the other days the ordinary laboratory duty was the only work performed.

The conclusion was reached that severe muscular exertion produced no increase in the metabolism of nitrogen with a diet rich or poor in protein, provided the total quantity of nutrients was sufficient for the demands of the organism.

Nos. 960–964 were made by Krummacher in the laboratory of the Physiological Institute at Bonn in 1890. The object was to investigate the influence of muscular exertion on nitrogen metabolism. The work is a continuation of that of Argutinsky (Nos. 941–948), and was intended to remove the objection that his results were not normal, but might have been influenced by personal characteristics. The investigator himself was the subject.

The food, which was very carefully prepared, consisted of meat, bread, milk, rice, wine, and pickled onions. Enough of each article was prepared to last through the whole experiment—14 days. The fat was determined in the food, except in the bread. In this it was calculated. The nitrogen in the food, urine, and feces was determined. The experiment was divided into five periods. In three periods no work was done, and in two periods the subject walked and climbed mountains. In the calculations no attention is paid to the energy expended in walking.

In No. 961 the subject climbed 1,137.7 meters. His weight was 68 kilograms. The work done was therefore estimated to be equal to 77,363.6 kilogrammeters or 182,000 calories. A gram of protein, according to Rubner, yields 4.2 calories. The above amount of muscular exertion would require, therefore, 43.33 grams of protein (or 6.713 grams of nitrogen). In reality, 4.326 grams, or 64.4 per cent, more nitrogen was metabolized when work was performed than when no work was done.

In No. 963 work was done on 2 days. The total height climbed was 2,403.79 meters. The weight of the subject being 67 kilograms, the work performed was estimated to equal 161,053.93 kilogrammeters, or 378,950 calories. This would require 90.23 grams of protein (or 13.99 grams of nitrogen). In reality, 6.771 grams, or 48 per cent, more nitrogen was actually metabolized than when no work was performed.

The agreement between the observed facts and Pflüger's theory that protein is the source of muscular energy is not as close as in Argutinsky's work.

[The same criticism which was made by Paton of Argutinsky's experiments applies to this work also, viz, that the very important matter of the energy used in walking ("forward progression") is left out of account entirely.]

Nos. 965–969 were made by Paton in one of the laboratories of the Royal College of Physicians in Edinburgh in 1891. The object of the experiment was to investigate the effect of muscular labor on the metabolism of nitrogen. The subject was a medical student 5 feet 6 inches tall. He was in good health and had for several years been accustomed to a simple, more or less strictly vegetable, diet.

The food was a simple mixed diet, consisting of soup made from beef and bone, oatmeal porridge, oatmeal biscuit, cocoa, butter, sugar, rice, stewed dried figs, and condensed milk. The nitrogen in each article was determined. Great care was used in the preparation of the food, when practicable a considerable quantity being prepared and kept on ice. The fat and carbohydrates were determined, except in the oatmeal, the biscuits, and the figs. The energy was calculated with the aid of Rubner's figures.

The work performed consisted in raising a weight a definite number of times by means of a pulley. To this may be added the labor of walking to and from the laboratory and ascending some stairs. The work of raising the weight 140 times amounted to 15,220 kilogrammeters, and that of ascending the stairs to 1,050 kilogrammeters. Using Zuntz's[1] figures, the energy of walking was calculated to be 21,076 kilogrammeters. The total was, therefore, 37,366 kilogrammeters. After performing the work the subject remained at home and kept as quiet as possible.

The conclusion was reached that the increased metabolism of protein indicated by

[1] Virchow's Arch., 121 (1890), p. 367.

the increased excretion of nitrogen would account for 35 per cent of the work performed and that the protein did not yield the greater part of muscular energy.

The conclusion is also reached that when the organism in a condition of comparative rest is called upon to perform a largely increased amount of work the protein and nonnitrogenous constituents undergo increased metabolism. In these experiments the amount of work was moderate, but large in comparison with the work done before and after—much larger than in experiments previously recorded.

[The conclusions do not agree with those of Argutinsky (Nos. 941–948). The probable reason for this is that Argutinsky neglected the motion of "forward progression," which must have called for a large amount of muscular exertion.]

It is noticed that the increased metabolism of protein is not accompanied by the increased excretion of nitrogen on the day work was done, but upon several succeeding days. This is a point of interest as, in the author's opinion, it invalidates the classic work of Fick and Wislicenus. This increase in the excretion of nitrogen may be due "to a retardation of the excretion of the effete nitrogen. But it strongly suggests the possibility that muscular work may in some way modify the constructive or anabolic change so that the nitrogenous part of the muscle substance is not again fully rebuilt into the structure of the molecule, but is allowed to escape and to undergo subsequent retrogressive changes in the liver."

Nos. 970–999 were made by Punine in St. Petersburg in 1894. The object was to study the influence of horseback riding on the metabolism and assimilation of nitrogen in healthy men. The subjects were soldiers of a battery of artillery guards, composed of horsemen and infantry, 8 of whom were recruits who had never ridden horseback and 7 were old soldiers. The subjects were divided into 5 groups, 3 of which consisted of recruits and 2 of old soldiers. Fifteen experiments are described, each divided into a riding period and a rest period of 5 days. The recruits began with the rest period and the old soldiers with the riding period. The riding exercises took place in the riding house, and continued from 1 to 3 hours a day.

The food consisted of a mixed diet. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author's conclusions were as follows: The assimilation of the protein of the food decreased under the influence of horseback riding from 1 to 8 per cent, or an average of 3.8 per cent. The metabolism of the protein increased from 2 to 37 per cent, or an average of 4.5 per cent, and the quality of the metabolism improved. During the period of horseback riding the weight of the body decreased, the quantity of urine decreased on an average 1,179 cubic centimeters, and the quantity of feces increased 670.4 grams.

Nos. 1000–1013 were made by Krummacher at the Physiological Institute in Munich in 1892. The object was to investigate the influence of muscular work upon the cleavage of protein. The subjects were the investigator himself and a laboratory servant. The food consisted of a mixed diet of rice, meat, milk, etc. The nitrogen in the food, urine, and feces was determined, and also the fat in the food. The carbohydrates in the food were calculated from earlier analyses, with the exception of the beer, and in this the extractive material was determined and assumed to be carbohydrates. The Kjeldahl method was used for determining the nitrogen in the food and feces, and sometimes in the urine, though the Schneider-Seegen method was more usual for the last determination. The separation of the feces was made with lampblack. In each experiment on one day a considerable amount of work was done, which consisted in turning the arm of a dynamometer of special construction.

The conclusion was reached that muscular work causes an increased cleavage of protein. This increase is less as the ratio of nitrogen-free material to protein in the food increases and is not directly connected with the amount of work performed. The author agrees with Voit in the opinion that usually work does not directly produce a greater breaking down of protein, but that an increase in the protein cleavage is caused by the increased combustion of the nitrogen-free materials which protect protein. If it were possible during the period of work to

continuously supply the cells with a sufficient amount of nitrogen-free material, then there would be no increase in the quantity of protein broken down. But this is a very difficult matter. The after effect of muscular labor has been noticed by a number of investigators. In the author's opinion, this effect is not due to the continued excretion of nitrogenous cleavage products, but to the fact that the nitrogen-free materials in the body were used up and that it takes some time to provide the body with a new supply. The author believes that under certain conditions it is possible for protein alone to be the source of muscular energy.

The subject is discussed from an historical and critical standpoint at considerable length.

Nos. 1014–1040[1] were made by Zavadovski in St. Petersburg in 1892. The object was to investigate the influence of a special breathing exercise upon the metabolism and assimilation of nitrogen in healthy subjects. The subjects were 8 hospital servants and a nurse. All the experiments were of 15 days' duration and were divided into 3 equal periods. The breathing exercise was practiced in the second period. It consisted of taking very deep breaths and expiring the air slowly. The exercise was performed as follows: The subjects stood in a row a few feet apart, the hands were placed on the ilium, and at a given signal the inspiration was begun. When the lungs were fully inflated a short pause was made and at another signal the expiration was commenced. The inspiration and the expiration each lasted about 5 seconds, and the pause between them was 3 or 4 seconds. There was also a pause of 3 or 4 seconds between each respiration. After 10 or 15 such inspirations a rest of 5 or 10 minutes was allowed. In every case the subjects were required to breathe through the nose. The breathing exercise was carried on from 9 to 10 o'clock in the morning, and from 12 to 2 and from 4 to 6 in the afternoon. At first the number of such respirations was 120 daily. The number was increased 15 or 20 each day, so that on the fifth day the number was about 200.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: The special breathing exercise practiced in these experiments increased the assimilation of nitrogen, and the increase was still noticed in the period following that with the breathing exercise. The metabolism of nitrogen was also increased, but the increase was dependent upon the quantity of fat in the food and on some other special features. Qualitatively the metabolism of nitrogen improved; that is, the ratio of incompletely oxidized products to nitrogen of urea decreased. The subjects gained somewhat in weight.

EXPERIMENTS TO DETERMINE THE EFFECT OF MASSAGE AND FARADIZATION.

In Table 11 are included 40 tests with men and 3 with children, in which the subjects received massage or faradization. Massage may perhaps be regarded as involuntary muscular exercise, and these experiments are connected with those in Table 9.

The massage was applied in accordance with the recognized methods. Although massage is often recommended as a therapeutic measure, the number of experiments on this subject is not large.

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[1] These experiments were included with those in which the influence of muscular work on the excretion of nitrogen was studied, because the breathing exercise practiced seemed similar to the labored breathing produced by severe muscular work, and, according to Zuntz (Experiment Station Record, 7, p. 549), it is only when breathing becomes labored that muscular exercise causes an increase in the metabolism of protein.

TABLE 11.—*Experiments to determine the effect of massage and faradization.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1041	1886	Gopadze	Medical student (S.)		61.7	495 gm. bread. 267 cc. milk, 113 gm. veal, 85 gm. roast beef, 317 cc. broth.	7	20.3	20.1	1.9	—1.7	
1042	1886	do	do		61.9	567 gm. bread, 364 cc. milk, 156 gm. veal, 124 gm. roast beef, 329 cc. broth.	7	25.5	26.5	1.9	—2.9	Massage.
1043	1886	do	do		61.5	575 gm. bread, 282 cc. milk, 178 gm. veal, 126 gm. roast beef, 294 cc. broth.	5	26.1	26.1	2.4	—2.4	
1044	1886	do	Medical student (P.)		64.2	478 gm. bread, 690 cc. milk, 143 gm. veal, 102 gm. roast beef, 497 cc. broth.	7	25.0	21.5	2.3	+1.2	
1045	1886	do	do		64.4	608 gm. bread, 914 cc. milk, 156 gm. veal, 147 gm. roast beef, 567 cc. broth.	7	30.7	27.4	2.2	+1.1	Do.
1046	1886	do	do		64.5	549 gm. bread, 971 cc. milk. 186 gm. veal, 110 gm. roast beef, 479 cc. broth.	7	29.6	23.0	2.4	+4.2	
1047	1886	do	Medical student (L.)		60.4	445 gm. bread, 790 cc. milk, 96 gm. veal, 115 gm. roast beef, 359 cc. broth.	7	22.4	21.5	1.9	—1.0	
1048	1886	do	do		59.6	468 gm. bread. 1,029 cc. milk. 99 gm. veal, 96 gm. roast beef, 300 cc. broth.	7	24.3	23.1	2.0	—0.8	Do.
1049	1886	do	do		59.5	463 gm. bread, 1,144 cc. milk, 114 gm. veal, 97 gm. roast beef. 257 cc. broth.	7	24.7	22.0	1.7	+1.0	
1050	1886	do	Medical student (Z.)		56.3	444 gm. bread, 857 cc. milk, 92 gm. veal, 106 gm. roast beef, 338 cc. broth.	7	22.1	19.5	2.0	+0.6	
1051	1886	do	do		56.5	451 gm. bread, 1,066 cc. milk, 102 gm. veal, 97 gm. roast beef, 286 cc. broth.	7	24.2	22.5	1.5	+0.2	Do.
1052	1886	do	do		56.8	391 gm. bread, 900 cc. milk, 107 gm. veal, 91 gm. roast beef, 250 cc. broth.	7	21.6	19.8	1.5	+0.3	
1053	1887	Walter	Man (F.)		65.0	597 gm. bread, 189 gm. meat, 1,057 cc. milk	3	26.1	17.5	2.2	+6.4	Enlarged liver.
1054	1887	do	do		64.4	419 gm. bread, 105 gm. meat, 827 cc. milk	3	18.0	15.1	1.5	+1.4	Enlarged liver. Faradization.
1055	1887	do	Man (P.)		43.1	628 gm. bread, 250 gm. meat, 1,158 cc. milk	3	29.9	26.0	3.5	+0.4	Hypertrophic cirrhosis of the liver.
1056	1887	do	do		43.3	498 gm. bread, 298 gm. meat, 983 cc. milk	3	28.4	27.6	2.5	—1.7	Hypertrophic cirrhosis of the liver. Faradization.
1057	1889	Kianovsky	Student (L.)		62.0	731.5 gm. bread, 300 gm. meat, 1,000 cc. milk, 75 gm. butter, 317 gm. jelly, 1,000 cc. tea, 67 cc. water.	6	26.8	21.4	3.7	+1.7	
1058	1889	do	do		62.9	831 gm. bread, 300 gm. meat, 1,033 cc. milk, 75 gm. butter, 300 gm. jelly, 1,000 cc. tea, 33 cc. water (1 day).	6	26.0	21.7	3.2	+1.1	Massage.

1059	1889	do	do		63.9	831 gm. bread, 300 gm. meat, 1,033 cc. milk, 75 gm. butter, 300 gm. jelly, 1,000 cc. tea, 33 cc. water.	6	27.0	20.8	3.5	+2.7	
1060	1889	do	Student (N.)		64.5	632 gm. bread, 200 gm. meat, 1,017 cc. milk, 75 gm. butter, 300 gm. jelly, 1,000 cc. tea, 167 cc. water.	6	25.2	20.6	2.4	+2.2	
1061	1889	do	do		67.0	597 gm. bread, 300 gm. meat, 1,000 cc. milk, 75 gm. butter, 300 gm. jelly, 1,200 cc. tea, 33 cc. water (1 day).	6	22.9	20.6	1.8	+0.5	Do.
1062	1889	d	do		67.1	633 gm. bread, 300 gm. meat, 1,000 cc. milk, 75 gm. butter, 300 gm. jelly, 1,200 cc. tea, 62 cc. water.	6	24.2	20.1	2.0	+2.1	
1063	1889	do	Student (Ph.)			589 gm. bread, 300 gm. meat, 933 cc. milk, 75 gm. butter, 300 gm. jelly, 917 cc. tea, — cc. water.	6	23.8	18.5	2.9	+2.4	
1064	1889	do	do			474 gm. bread, 300 gm. meat, 867 cc. milk, 75 gm. butter, 300 gm. jelly, 667 cc. tea, — cc. water.	6	20.6	18.3	2.2	+0.1	Massage.
1065	1889	do	do			514 gm. bread, 300 gm. meat, 667 cc. milk, 75 gm. butter, 300 gm. jelly, 773 cc. tea, — cc. water.	6	20.9	17.8	2.3	+0.8	Nitrogen in urine determined, 5 days.
1066	1889	do	Student (B.)			697 gm. bread, 300 gm. meat, 933 cc. milk, 50 gm. butter, 300 gm. jelly, 967 cc. tea, 33 cc. water.	6	24.8	22.2	1.5	+1.1	
1067	1889	do	do			693 gm. bread, 300 gm. meat, 933 cc. milk, 50 gm. butter, 300 gm. jelly, 933 cc. tea, 33 cc. water (1 day).	6	25.6	23.4	1.2	+1.0	Massage.
1068	1889	do	do			598 gm. bread, 300 gm. meat, 800 cc. milk, 50 gm. butter, 300 gm. jelly, 863 cc. tea, 50 cc. water.	6	22.8	21.9	1.3	—0.4	
1069	1889	do	Student (Ph.)			508 gm. bread, 360 gm. meat, 808 cc. milk, 417 gm. bouillon, 349 gm. jelly, 1,062 cc. tea, 267 cc. water.	6	29.5	25.1	3.4	+1.0	
1070	1889	do	do			512 gm. bread, 402 gm. meat, 800 cc. milk, 433 gm. bouillon, 389 gm. jelly, 967 cc. tea, 533 cc. water.	6	34.9	32.5	2.0	+0.4	Do.
1071	1889	do	do			543 gm. bread, 321 gm. meat, 658 cc. milk, 600 gm. bouillon, 325 gm. jelly, 1,100 cc. tea, 333 cc. water (1 day).	6	29.8	26.4	2.5	+0.9	
1072	1889	do	Student (M.)			460 gm. bread, 398 gm. meat, 955 cc. milk, 620 gm. bouillon, 392 gm. jelly, 1,082 cc. tea, 178 cc. water.	6	33.1	29.4	1.9	+1.8	
1073	1889	do	do			656 gm. bread, 442 gm. meat, 665 cc. milk, 637 gm. bouillon, 400 gm. jelly, 1,172 cc. tea, 33 cc. water (1 day).	6	38.1	35.7	1.7	+0.7	Massage. Water consumed on only 1 day.
1074	1889	do	do			465 gm. bread, 439 gm. meat, 952 cc. milk, 515 gm. bouillon, 378 gm. jelly, 1,032 cc. tea, 110 cc. water.	6	34.9	32.2	1.2	+1.5	
1075	1889	do	Student (M.)			631 gm. bread, 300 gm. meat, 933 cc. milk, 50 gm. butter, 200 gm. jelly, 867 cc. tea, — cc. water.	6	24.2	19.6	2.3	+2.3	

TABLE 11.—*Experiments to determine the effect of massage and faradization*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1076	1889	Kianovsky	Student (M.)			705 gm. bread, 300 gm. meat, 833 cc. milk, 50 gm. butter, 200 gm. jelly, 933 cc. tea, — cc. water.	6	24.8	21.0	1.8	+2.0	Massage. Nitrogen in urine determined, 5 days.
1077	1889	....do	Student (A.)			560 gm. bread, 355 gm. meat, 690 cc. milk, 233 gm. bouillon, 304 gm. jelly, 2,260 cc. tea, — cc. water.	6	30.6	26.1	3.3	+1.2	
1078	1889	....do	....do			584 gm. bread, 395 gm. meat, 422 cc. milk, 460 gm. bouillon, 350 gm. jelly, 1,880 cc. tea, — cc. water.	6	31.5	28.0	2.7	+0.8	Massage.
1079	1889	....do	Observer			422 gm. bread, 244 gm. meat, 753 cc. milk, 186 gm. bouillon, 262 gm. jelly, 1,417 cc. tea, — cc. water.	6	22.6	21.6	1.5	—0.5	
1080	1889	....do	....do			467 gm. bread, 334 gm. meat, 448 cc. milk, 358 gm. bouillon, 313 gm. jelly, 1,815 cc. tea, — cc. water.	6	26.8	26.4	1.3	—0.9	Do.
1081	1894	Bendix	Boy	2½	14.3	1,250 gm. sterilized milk, 70 gm. white bread, 62.5 gm. chocolate, 20 gm. apple jelly (47.8 gm. protein, 60.0 gm. fat, 120.9 gm. carbohydrates, 1,222 calories).	11	7.7	4.7	1.0	+2.0	
1082	1894	....do	....do			....do	7	7.7	5.4	1.3	+1.0	Do.
1083	1895	....do	....do			....do	8	7.7	5.6	1.2	+0.9	Nitrogen in feces determined, 7 days.

Nos. 1041–1043. The influence of massage on the metabolism of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1886. p. 14, Table 1. Nos. 1044–1046. Ibid., Table 2. Nos. 1047–1049. Ibid., p. 16, Table 3. Nos. 1050–1052. Ibid., Table 4. Nos. 1053–1056. Vrach, 8, p. 805. Nos. 1057–1059. The influence of abdominal massage on the assimilation of nitrogen and fat by healthy individuals. Inaug. Diss. (Russian), St. Petersburg, 1889, p. 46, Table 1. Nos. 1060–1062. Ibid., Table 2. Nos. 1063–1065. Ibid., p. 48, Table 3. Nos. 1066–1068. Ibid., Table 4. Nos. 1069–1071. Ibid., p. 50, Table 5. Nos. 1072–1074. Ibid., Table 6. Nos. 1075, 1076. Ibid., p. 52, Table 7. Nos. 1077, 1078. Ibid., Table 8. Nos. 1079, 1080. Ibid., p. 54, Table 9. Nos. 1081–1083. Ztschr. klin. Med., 25, pp. 318, 319.

Nos. 1041–1052 were made by Gopadze in St. Petersburg in 1886.

The author studied the influence of massage on the metabolism of nitrogen and the assimilation of protein, and its effects on the pulse, respiration, temperature and the weight of the body, and the quantities and consistency of the feces. All the subjects were healthy medical students.

Four series of experiments are described. Each experiment was divided into three periods of 7 days each. In the first experiment the last period was limited to 5 days in consequence of diarrhea. The food was uniform in all cases and consisted of white bread, milk, broth, veal, and roast beef, besides 2 to 3 cups of tea morning and evening. The determination of the nitrogen of the food, feces, and urine was made by the Kjeldahl-Borodin method. The feces were separated by means of stewed blackberries. Each subject was weighed once in the morning after urinating and before taking food, and once in the evening after the last meal and after urinating.

During the second period massage was applied for 20 to 25 minutes each day 2 or 3 hours after breakfast or 3 hours after dinner. The massage consisted of stroking (*effleurage*), friction, kneading (*petrissage*), and pounding (*topotement*). The whole body except the head and neck was subjected to this treatment.

The author sums up the results of his experiments as follows:

Under the influence of massage the appetite increased considerably in all four cases, and the intensified appetite continued during the period following massage. The metabolism of nitrogen was intensified in all cases.

The assimilation of the nitrogenous constituents of the food improved under the influence of massage in all cases, notwithstanding the increased quantities of food taken. The improved assimilation continued in the third period, though in a less degree. The inconsiderable improvement of assimilation in No. 1048 is accounted for by diarrhea.

The subjects of Nos. 1044–1046 and 1050–1052 increased in weight, and the subjects of Nos. 1041–1043 and 1047–1049 decreased in weight, in the massage period. In the third period all the subjects increased in weight.

Nos. 1053–1056 were made by Walter in St. Petersburg in 1887. The object was to study the influence of faradization in the region of the liver on the metabolism of nitrogen and its excretion in the urine. The subject of the first experiment was suffering from an enlarged liver, the cause of which was not quite clear, and the subject of the second had a hypertrophic affection of the liver. Both experiments lasted 6 days, and were divided into two equal periods. In the second period faradization treatment was employed.

The faradization was carried on by Sigrist's method—that is, one electrode was placed on the pit of the stomach and the other at different points in the region of the liver. The application was made for 15 minutes twice a day.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author concluded that faradization of the region of the liver caused a slight increase in the amount of nitrogen excreted in the urine.

Nos. 1057–1080 were made by Kianovsky in St. Petersburg in 1889. The object was to study the influence of abdominal massage on the assimilation and metabolism of nitrogen. The influence of abdominal massage on the assimilation of fats was observed in several cases. Some experiments consisted of two and some of three periods. In every case massage was applied in the second period. Nearly all periods lasted 6 days. The subjects were all healthy persons—8 medical students and the author. The food consisted of milk, beef tea, roasted meat, bread, jelly, etc. The jelly was made from blueberries. Between 10 and 11 a. m. the subjects took tea; at 12 to 1 p. m. breakfast, consisting of milk, bread, butter, and meat; at 3 to 5 p. m., dinner; and from 8 to 11, tea. Abdominal massage was applied between 11 and 12 o'clock, and in two experiments about 5 hours after dinner also.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author sums up the results of his experiments as follows:

Under the influence of abdominal massage the assimilation of the nitrogenous constituents of the food improved in every case from 1.4 to 5.76 per cent. In the period after massage the assimilation of nitrogen continued to improve in only one case (No. 1065); in three other cases (Nos. 1059, 1062, and 1068) it somewhat deteriorated as compared with the massage period, but remains improved as compared with the ante-massage period. The assimilation of fats improved during the massage period. The metabolism of nitrogen increased from 0.6 to 10.9 per cent. The appetite of almost all the subjects improved. Notwithstanding the increase of the metabolism of nitrogen, many of the subjects gradually increased in weight. After each massage treatment the subjects had a feeling of lassitude and drowsiness.

Nos. 1081–1083 were made by Bendix at the laboratory of the department of animal physiology of the Royal Agricultural Institute in Berlin in 1894 (?). The subject was a boy 2½ years old. The object was to observe the effect of massage on metabolism. The experiment was divided into four periods, three of which are included in this table. Massage was applied in the second period. The method of massage was not stated. The food consisted of sterilized milk, chocolate, white bread, and apple jelly. The nitrogen and fat in the food and feces, and the nitrogen in the urine, were determined. The carbohydrates in the food were calculated.

In the fourth period (6 days) the same amount of nitrogen as in the other periods was consumed daily and 4.8 grams was excreted in the urine. No analysis of feces for this period is reported. The author made two other experiments in which analyses of feces are not reported. The subject of the first test was a man 26 years old. The test was divided into two periods of 6 and 3 days, with massage in the second period. During the whole test a mixed diet was consumed which furnished 16.5 grams of nitrogen daily. Before massage the urine contained on an average 11.6 grams of nitrogen and during the massage period 12.7 grams. The second test was made with a woman 25 years old and was divided into five periods, the first three and the last period of 4 days' duration and the fourth of 9 days. The subject was massaged in the second and fourth periods. A mixed diet uniform throughout the test was consumed which furnished 15.3 grams of nitrogen daily. The average daily excretion of nitrogen in the urine in the different periods was 12.0, 13.7, 13.2, 13.5, and 12.6 grams, respectively.

The conclusion was reached that massage increases the amount of urine and the excretion of nitrogen in the urine. These results were noticeable for several days after the end of the massage period.

EXPERIMENTS TO DETERMINE THE EFFECT OF BATHS AND ENEMAS.

In Table 12 are included 276 tests with men and 12 with children, in which baths of various sorts were given to subjects living under more or less normal conditions, and 24 experiments in which the subjects were given enemas. The baths were of various sorts—cold baths, douches, baths in natural or artificially prepared mineral water, and Russian baths. In several cases they were accompanied by rubbing or massage. A number of tests were also made with mud baths and sand baths. In many instances the treatment was such as to induce copious perspiration. This was true of the hot-air bath. Other experiments with diseased subjects, in which baths of various sorts were given, will be found in Tables 17–22. Experiments of a similar nature with dogs will be found in Table 29 (Nos. 2956–2962).

TABLE 12.—*Experiments to determine the effect of baths and enemas.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1084	1886	Frantzius	Schoolboy (T.)	11	32.7	347 gm. bread, 76 gm. beef, 84 gm. veal, 153 gm. manna, 300 cc. soup, 225 gm. kvass, 375 gm. water, 1,537 cc. milk.	4	24.1	15.5	4.2	+ 4.4	
1085	1886	....do	....do	11	32.8	300 gm. bread, 119 gm. beef, 39 gm. veal, 186 gm. manna, 138 gm. curdled milk, 91 gm. jelly, 391 cc. soup, 1,628 cc. milk, 814 gm. kvass, 986 gm. water.	7	25.2	18.4	4.3	+ 1.5	Fresh-water baths.
1086	1886	....do	....do	11	32.2	214 gm. bread, 132 gm. beef, 41 gm. veal, 228 gm. manna, 208 gm. curdled milk, 102 gm. jelly, 431 cc. soup, 1,343 cc. milk, 214 gm. kvass, 728 gm. water.	7	25.0	21.2	4.0	— 0.2	Mineral-water baths.
1087	1886	....do	Schoolboy (B.)	13	41.1	370 gm. bread, 111 gm. beef, 72 gm. veal, 163 gm. manna, 300 cc. soup, 1,350 cc. milk, 382 gm. kvass, 450 gm. water.	4	23.9	15.4	3.3	+ 5.2	
1088	1886	....do	....do	13	41.5	407 gm. bread, 149 gm. beef, 53 gm. veal, 282 gm. manna, 166 gm. curdled milk, 92 gm. jelly, 399 cc. soup, 1,353 cc. milk, 814 gm. kvass, 257 gm. water.	7	28.2	17.9	3.9	+ 6.4	Fresh-water baths.
1089	1886	....do	....do	13	42.4	358 gm. bread, 155 gm. beef, 53 gm. veal, 222 gm. manna, 219 gm. curdled milk, 105 gm. jelly, 476 cc. soup, 1,350 cc. milk, 343 gm. kvass, 257 gm. water.	7	28.5	21.7	3.9	+ 2.9	Mineral-water baths.
1090	1886	....do	Gymnasium student (L.).	13	34.4	351 gm. bread, 110 gm. beef, 85 gm. veal, 156 gm. manna, 300 cc. soup, 1,275 cc. milk, 300 gm. kvass, 75 gm. water.	4	23.6	14.6	3.5	+ 5.5	
1091	1886	....do	.... do	13	35.6	365 gm. bread, 116 gm. beef, 47 gm. veal, 245 gm. manna, 128 gm. curdled milk, 98 gm. jelly, 353 cc. soup, 1,168 cc. milk, 364 gm. kvass, 257 gm. water.	7	23.8	17.3	3.1	+ 3.4	Do.
1092	1886	....do	....do	13	36.2	388 gm. bread, 117 gm. beef, 39 gm. veal, 335 gm. manna, 189 gm. curdled milk, 89 gm. jelly, 351 cc. soup, 1,114 cc. milk, 214 gm. kvass, 471 gm. water.	7	25.3	19.1	2.6	+ 3.6	Fresh-water baths.
1093	1886	....do	Gymnasium student (L.).	13	34.3	364 gm. bread, 96 gm. beef, 71 gm. veal, 183 gm. manna, 306 cc. soup, 900 cc. milk, 450 gm. kvass, 75 gm. water.	4	20.5	14.6	2.9	+ 3.0	

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (−).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1094	1886	Frantzius	Gymnasium student (L.).	13	35.0	365 gm. bread, 125 gm. beef, 41 gm. veal, 182 gm. manna, 118 gm. curdled milk, 105 gm. jelly, 321 cc. soup, 696 cc. milk, 707 gm. kvass, 107 gm. water.	7	20.5	15.5	2.8	+ 2.2	Mineral-water baths.
1095	1886	....do	....do	13	35.6	285 gm. bread, 122 gm. beef, 38 gm. veal, 222 gm. manna, 126 gm. curdled milk, 97 gm. jelly, 266 cc. soup, 829 cc. milk, 258 gm. kvass, 450 gm. water.	7	20.5	15.5	2.6	+ 2.4	Fresh-water baths.
1096	1887	Feit	Student (L.)	25	60.4	387 gm. bread, 1,180 cc. milk, 143 gm. veal, 154 gm. roast beef, 200 cc. bouillon.	7	27.5	20.7	2.8	+ 4.0	
1097	1887	....do	....do	25	60.8	539 gm. bread, 1,300 cc. milk, 124 gm. veal, 153 gm. roast beef, 157 gm. bouillon.	7	30.2	24.9	2.9	+ 2.4	Friction.
1098	1887	....do	....do	25	61.3	515 gm. bread, 1,357 cc. milk, 158 gm. veal, 134 gm. roast beef, 157 gm. bouillon.	7	30.7	27.5	2.9	+ 0.3	
1099	1887	....do	Student (E.)	25	56.3	228 gm. bread. 1,024 cc. milk, 108 gm. veal, 136 gm. roast beef, 171 gm. bouillon.	7	24.2	16.1	0.8	+ 7.3	
1100	1887	....do	....do	25	56.2	387 gm. bread, 973 cc. milk, 83 gm. veal, 83 gm. roast beef, 107 gm. bouillon.	7	20.2	19.6	1.0	— 0.4	Do.
1101	1887	....do	....do	25	56.0	427 bread, 1,000 cc. milk, 91 gm. veal, 79 gm. roast beef, 78 gm. bouillon.	7	21.6	19.4	1.4	+ 0.8	
1102	1887	....do	Student (Sh.)	23	57.8	533 gm. bread, 529 cc. milk, 86 gm. veal, 135 gm. roast beef, 471 gm. bouillon.	7	22.4	18.7	2.7	+ 1.0	
1103	1887	....do	....do	23	57.5	483 gm. bread, 514 cc. milk, 113 gm. veal, 179 gm. roast beef. 443 gm. bouillon.	7	25.0	22.1	2.1	+ 0.8	Do.
1104	1887	....do	....do	23	57.5	624 gm. bread, 257 cc. milk, 76 gm. veal, 170 gm. roast beef, 486 gm. bouillon.	7	22.9	18.9	2.4	+ 1.6	
1105	1887	....do	Student (I.)	25	52.0	476 gm. bread, 600 cc. milk, 83 gm. veal, 77 gm. roast beef, 229 gm. bouillon.	7	18.3	15.3	1.5	+ 1.5	
1106	1887	....do	....do	25	51.6	527 gm. bread, 629 cc. milk, 102 gm. veal, 75 gm. roast beef, 229 gm. bouillon.	7	20.0	17.3	1.5	+ 1.2	Do.
1107	1887	....do	....do	25	52.0	531 gm. bread, 657 cc. milk, 60 gm. veal, 95 gm. roast beef, 229 gm. bouillon.	7	18.8	15.0	1.8	+ 2.0	
1108	1887	Evdokimov	Soldier (O.)	24	57.2	— gm. bread, 1,700-2,100 cc. milk, 800-1,000 cc. tea.	3	19.4	16.5	1.4	+ 1.5	
1110	1887	....do	....do	24	56.0	....do	2	19.4	16.4	1.3	+ 1.7	Baths and sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 895 gm.

1110	1887	.....do	.....do	24	56.7	.....do	2	20.3	20.0	2.0	— 1.7	
1111	1887	.....do	Soldier (M.)	25	59.4	— gm. bread, 2,310-3,100 cc. milk, 690-1,265 cc. tea.	3	23.7	17.8	1.3	+ 4.6	
1112	1887	.....do	.....do	25	58.8	.....do	2	23.7	12.3	0.8	+10.6	Baths and sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 1,290 gm.
1113	1887	.....do	.....do	25	59.3	.....do	2	21.5	16.3	1.4	+ 3.8	
1114	1887	.....do	Soldier (K.)	25	61.5	— gm. bread, 2,330-2,750 cc. milk, 210-1,680 cc. tea.	3	27.7	17.3	3.7	+ 6.7	
1115	1887	.....do	.....do	25	61.6	.....do	2	30.4	19.3	2.3	+ 8.8	Baths and sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 1,600 gm.
1116	1887	.....do	.....do	25	62.0	.....do	2	30.2	16.2	6.5	+ 7.5	
1117	1887	.....do	Soldier	25	62.7	— gm. bread, 3,200 cc. milk, 1,080-1,280 cc. tea.	3	30.2	18.3	2.4	+ 9.5	
1118	1887	.....do	.....do	25	62.7	.....do	2	30.8	19.7	2.1	+ 9.0	Baths and sweating — 0.2 gm. nitrogen in sweat. Loss in weight, 1,460 gm.
1119	1887	.....do	.....do	25	62.5	.....do	2	28.8	16.8	2.8	+ 9.2	
1120	1887	.....do	Soldier (F.)	26	54.2	— gm. bread, 3,200 cc. milk, 800 cc. tea	3	24.3	14.0	1.8	+ 7.5	
1121	1887	.....do	.....do	26	54.6	.....do	2	24.8	14.4	1.2	+ 9.2	Baths and sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 650 gm.
1122	1887	.....do	.....do	26	54.0	.....do	2	26.3	12.4	4.2	+ 9.7	
1123	1887	.....do	Copyist (P.)	26	60.7	2,088 cc. milk, 1,006 gm. bread, 800 cc. tea	5	28.2	20.0	1.9	+ 6.3	
1124	1887	.....do	.....do	26	61.8	2,400 cc. milk, 1,130 gm. bread, 800 cc. tea	2	32.0	20.4	0.5	+11.1	Baths and sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 560 gm.
1125	1887	.....do	.....do	26	61.9	2,400 cc. milk, 1,151 gm. bread, 800 cc. tea	3	32.4	22.3	3.3	+ 6.8	
1126	1887	.....do	Sergeant (K.)	41	54.9	2,200 cc. milk, 891 gm. bread, 1,150 cc. tea	5	26.2	16.9	1.5	+ 7.8	
1127	1887	.....do	.....do	41	54.7	2,400 cc. milk, 1,147 gm. bread, 1,150 cc. tea	2	31.5	15.6	1.1	+14.8	Baths and sweating — 0.04 gm. nitrogen in sweat. Loss in weight, 385 gm.
1128	1887	.....do	.....do	41	54.9	2,400 cc. milk, 726 gm. bread, 1,150 cc. tea	2	24.0	17.3	0.9	+ 5.8	
1129	1887	.....do	Peasant (D.)	26	57.0	950 cc. milk, 455 gm. bread, 360 cc. tea	2	9.4	4.2	3.9	+ 1.3	Nephritis parenc. acuta.
1130	1887	.....do	.....do	26	56.7	1,000 cc. milk, 626 gm. bread, 360 cc. tea	5	10.3	9.6	2.0	— 1.3	Nephritis parenc. acuta. Baths, sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 677 gm. (3 days).
1131	1887	.....do	.....do	26	53.4	1,000 cc. milk, 748 gm. bread, 360 cc. tea	3	12.5	7.5	2.3	+ 2.7	Nephritis parenc. acuta.
1132	1887	.....do	.....do	26	48.7	1,490 cc. milk, 743 gm. bread, 360 cc. tea	3	14.9	13.6	1.7	— 0.4	Nephritis parenc. acuta. Baths, sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 795 gm. (2 days).

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1133	1887	Evdokimov	Peasant (K.)	33	83.4	2,400 cc. milk, 340 gm. bread, 800 cc. tea	4	18.2	8.5	1.0	+ 8.7	Nephritis dif. chron. et cirrhosis hepatis.
1134	1887	....do	....do	33	80.6	2,400 cc. milk, 312 gm. bread, 800 cc. tea	5	18.2	7.6	0.7	+ 9.9	Nephritis dif. chron. et cirrhosis hepatis. Baths, sweating — 0.2 gm. nitrogen in sweat. Loss in weight, 874 gm. (4 days).
1135	1887	....do	....do	33	78.4	2,400 cc. milk, 327 gm. bread, 800 cc. tea	3	17.8	5.5	1.1	+11.2	Nephritis dif. chron. et cirrhosis hepatis.
1136	1887	....do	....do	33	77.5	2,400 cc. milk, 391 gm. bread, 800 cc. tea	10	19.2	9.6	1.2	+ 8.4	Nephritis dif. chron. et cirrhosis hepatis. Baths, sweating — 0.1 gm. nitrogen in sweat. Loss in weight, 1,063 gm. (3 days).
1137	1887	....do	....do	33	74.9	2,400 cc. milk, 760 gm. bread, 800 cc. tea	3	26.8	15.6	1.2	+10.0	Nephritis dif. chron. et cirrhosis hepatis.
1138	1887	Sigrist	Man	......	......	Mixed diet (about 4 glasses of liquids)	5	37.7	30.8	3.0	+ 3.9	
1139	1887	....do	....do	......	......	Mixed diet (about 3 glasses of liquids)	5	37.4	30.2	3.5	+ 3.7	Fresh-water baths.
1140	1887	....do	....do	......	......	....do	5	36.2	27.9	3.1	+ 5.2	Salt alkaline baths.
1141	1887	....do	....do	......	......	Mixed diet (about 5 glasses of liquids)	4	31.2	27.5	2.3	+ 1.4	
1142	1887	....do	....do	......	......	Mixed diet (about 6 glasses of liquids)	4	32.0	27.3	2.4	+ 2.3	Fresh-water baths.
1143	1887	....do	....do	......	......	....do	4	37.2	29.6	2.6	+ 5.0	Salt alkaline baths.
1144	1887	Garine	Man (M.)	23	52	880 gm. bread, 302 gm. meat, 660 cc. milk, 2,400 cc. tea.	5	27.8	24.8	2.9	+ 0.1	
1145	1887	....do	....do	23	53	897 gm. bread, 271 gm. meat, 420 cc. milk, 2,840 cc. tea.	5	30.0	30.6	3.9	— 4.5	Hot-air baths of 20 minutes' duration.
1146	1887	....do	....do	23	52	894 gm. bread, 242 gm. meat, 570 cc. milk, 2,520 cc. tea.	5	29.7	28.3	3.2	— 1.8	
1147	1887	....do	Retired soldier (A.)	29	67	1,146 gm. bread, 300 gm. meat, 600 cc. milk, 330 cc. tea.	5	37.4	27.9	4.0	+ 5.5	
1148	1887	....do	....do	29	67	1,322 gm. bread, 300 gm. meat, 600 cc. milk, 3,660 cc. tea.	5	41.5	39.3	4.2	— 2.0	Hot air baths of 15 to 25 minutes' duration.
1149	1887	....do	....do	29	68	1,156 gm. bread, 280 gm. meat, 600 cc. milk, 3,360 cc. tea.	5	37.2	31.3	3.0	+ 2.9	
1150	1887	....do	Peasant (S.)	22	62	937 gm. bread, 304 gm. meat, 600 cc. milk, 2 000 cc. tea.	5	25.1	24.3	3.2	— 2.4	

1151	1887	.....do	.....do	22	62	877 gm. bread, 284 gm. meat, 560 cc. milk, 2,200 cc. tea.	5	25.0	30.4	6.4	—11.8	Hot-air baths of 20 to 25 minutes' duration.
1152	1887	.....do	.....do	22	62	804 gm. bread, 286 gm. meat, 514 cc. milk, 2,200 cc. tea.	5	26.7	25.8	3.4	— 2.5	
1153	1887	.....do	Physician (K.)	25	87	166 gm. bread, 224 gm. meat, 100 gm. cheese, 2,430 cc. tea.	3	18.6	15.6	1.7	+ 1.3	
1154	1887	.....do	.....do	25	88	107 gm. bread, 214 gm. meat, 77 gm. cheese, 480 gm. bouillon, 3,093 cc. tea.	6	15.1	17.9	1.5	— 4.3	Hot-air baths of 15 to 20 minutes' duration.
1155	1887	.....do	.....do	25	87	208 gm. bread, 253 gm. meat, 114 gm. cheese, 2,498 cc. tea.	4	16.7	15.7	2.1	— 1.1	
1156	1887	.....do	Waiter (K.)	48	53	440 gm. bread, 300 gm. meat, 1,860 cc. milk, 2,400 cc. tea.	5	30.7	15.8	3.5	+11.4	Acute interstitial nephritis.
1157	1887	.....do	.....do	48	54	341 gm. bread, 238 gm. meat, 2,220 cc. milk, 2,544 cc. tea.	5	27.6	18.8	2.7	+ 6.1	Acute interstitial nephritis. Hot-air baths of 20 to 25 minutes' duration.
1158	1887	.....do	.....do	48	55	436 gm. bread, 287 gm. meat, 1,680 cc. milk, 2,928 cc. tea.	5	31.9	24.2	3.2	+ 4.5	Acute interstitial nephritis.
1159	1887	.....do	Soldier (K.)	39	75	183 gm. bread, 175 gm. meat, 1,621 cc. milk, 1,334 cc. tea.	5	20.8	7.9	6.5	+ 6.4	Do.
1160	1887	.....do	.....do	39	70	227 gm. bread, 178 gm. meat, 1,580 cc. milk, 1,798 cc. tea.	5	20.4	11.4	6.0	+ 3.0	Acute interstitial nephritis. Hot-air baths of 25 to 35 minutes' duration.
1161	1887	.....do	.....do	39	66	176 gm. bread, 139 gm. meat, 1,500 cc. milk, 1,972 cc. tea.	5	18.6	9.9	6.1	+ 2.6	Acute interstitial nephritis.
1162	1888	Blagoveschchenski.	Prisoner (K.)	26	80.6	1,027 gm. bread, 35 gm. butter, 222 gm. roast beef, 118 gm. beef, 1,139 cc. soup, 694 cc. milk, 38 gm. blackberries (1 day).	6	35.0	28.9	3.5	+ 2.6	
1163	1888	.....do	.....do	26	81.2	1,031 gm. bread, 31 gm. butter, 249 gm. roast beef, 149 gm. beef, 1,087 cc. soup, 642 cc. milk, 30 gm. blackberries (1 day).	5	44.3	38.4	3.5	+ 2.4	Affusions, water 15° C.
1164	1888	.....do	.....do	26	82.2	1,025 gm. bread, 25 gm. butter, 244 gm. roast beef, 93 gm. beef, 1,045 cc. soup, 682 cc. milk, 27 gm. blackberries (1 day).	4	44.0	36.9	3.0	+ 4.1	
1165	1888	.....do	Prisoner (S.)	28	57.3	917 gm. bread, 34 gm. butter, 209 gm. roast beef, 104 gm. beef, 1,155 cc. soup, 673 cc. milk, 42 gm. blackberries (1 day).	6	32.6	26.0	3.7	+ 2.9	
1166	1888	.....do	.....do	28	57.8	941 gm. bread, 36 gm. butter, 177 gm. roast beef, 132 gm. beef, 1,265 cc. soup, 682 cc. milk, 30 gm. blackberries (1 day).	5	38.7	32.9	3.7	+ 2.1	Do.
1167	1888	.....do	.....do	28	58.5	946 gm. bread, 24 gm. butter, 192 gm. roast beef, 98 gm. beef, 1,103 cc. soup, 713 cc. milk, 24 gm. blackberries (1 day).	4	40.1	32.9	3.7	+ 3.5	
1168	1888	.....do	Prisoner (K.)	20	65.1	1,199 gm. bread, 35 gm. butter, 241 gm. roast beef, 105 gm. beef, 1,276 cc. soup, 718 cc. milk.	4	41.1	30.5	5.0	+ 5.6	
1169	1888	.....do	.....do	20	66.5	1,277 gm. bread, 35 gm. butter, 220 gm. roast beef, 114 gm. beef, 1,177 cc. soup, 675 cc. milk, 19 gm. blackberries (1 day).	4	43.3	33.8	4.5	+ 5.0	Do.

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1170	1888	Blagoveschenski.	Prisoner (K.)	20	67.3	1,148 gm. bread, 35 gm. butter, 218 gm. roast beef, 135 gm. beef, 1,331 cc. soup, 696 cc. milk, 20 gm. blackberries (1 day).	4	41.2	33.7	4.1	+3.4	
1171	1888	do	Prisoner (Tz.)	19	54.3	1,065 gm. bread, 35 gm. butter, 233 gm. roast beef, 97 gm. beef, 1,042 cc. soup, 729 cc. milk.	4	38.0	30.2	3.1	+4.7	
1172	1888	do	do	19	53.8	1,121 gm. bread, 35 gm. butter, 218 gm. roast beef, 107 gm. beef, 1,098 cc. soup, 694 cc. milk, 24 gm. blackberries (1 day).	4	38.8	33.2	3.2	+2.4	Affusions, water 15° C.
1173	1888	do	do	19	58.0	1,075 gm. bread, 35 gm. butter, 198 gm. roast beef, 140 gm. beef, 1,023 cc. soup, 690 cc. milk, 19 gm. blackberries (1 day).	4	39.1	33.2	3.2	+2.7	
1174	1888	do	Prisoner (K.)	26	82.3	1,053 gm. bread, 35 gm. butter, 215 gm. roast beef, 123 gm. beef, 1,135 cc. soup, 728 cc. milk, 25 gm. blackberries (1 day).	5	42.7	33.1	3.8	+5.8	
1175	1888	do	do	26	83.3	1,117 gm. bread, 29 gm. butter, 211 gm. roast beef, 144 gm. beef, 1,126 cc. soup, 720 cc. milk, 23 gm. blackberries (1 day).	5	42.0	35.4	2.2	+4.4	Affusions, water 23° C.
1176	1888	do	do	26	83.0	1,075 gm. bread, 22 gm. butter, 109 gm. roast beef, 115 gm. beef, 684 cc. soup, 693 cc. milk, 21 gm. blackberries (1 day).	5	34.9	30.4	3.5	+1.0	
1177	1888	do	Prisoner (S.)	28	59.3	898 gm. bread, 35 gm. butter, 189 gm. roast beef, 123 gm. beef, 950 cc. soup, 700 cc. milk, 25 gm. blackberries (1 day).	5	37.2	28.9	2.9	+7.4	
1178	1888	do	do	28	60.0	800 gm. bread, 34 gm. butter, 204 gm. roast beef, 139 gm. beef, 964 cc. soup, 726 cc. milk, 23 gm. blackberries (1 day).	5	36.0	30.5	2.4	+3.1	Do.
1179	1888	do	do	28	59.8	672 gm. bread, 29 gm. butter, 253 gm. roast beef, 240 gm. beef, 1,035 cc. soup, 19 gm. blackberries (1 day).	5	40.6	34.2	1.5	+4.9	
1180	1888	do	Prisoner (K.)	20	68.0	995 gm. bread, 33 gm. butter, 174 gm. roast beef, 141 gm. beef, 1,053 cc. soup, 699 cc. milk, 20 gm. blackberries (1 day).	5	37.5	31.1	3.7	+2.7	
1181	1888	do	do	20	67.8	1,048 gm. bread, 29 gm. butter, 265 gm. roast beef, 117 gm. beef, 788 cc. soup, 717 cc. milk, 20 gm. blackberries (1 day).	5	38.5	33.6	2.9	+2.0	Do.

1182	1888	.....do	.....do	20	68.3	1,067 gm. bread. 28 gm. butter, 100 gm. roast beef. 90 gm. beef, 607 cc. soup, 693 cc. milk, 20 gm. blackberries (1 day).	5	33.5	27.8	3.6	+2.1	
1183	1888	.....do	Prisoner (Uz.)	19	58.0	903 gm. bread, 33 gm. butter, 207 gm. roast beef, 106 gm. beef, 1,090 cc. soup, 709 cc. milk, 20 gm. blackberries (1 day).	5	36.0	30.0	3.5	+2.5	
1184	1888	.....do	.....do	19	58.5	820 gm. bread, 30 gm. butter, 239 gm. roast beef. 120 gm. beef, 1,140 cc. soup, 692 cc. milk, 20 gm. blackberries (1 day).	5	36.9	32.1	2.6	+2.2	Do.
1185	1888	.....do	.....do	19	59.8	917 gm. bread, 28 gm. butter, 145 gm. roast beef, 168 gm. beef, 1,078 cc. soup, 692 cc. milk, 20 gm. blackberries (1 day).	5	36.6	29.0	3.0	+4.6	
1186	1888	Makovetski	Medical student (B.)	....	61.2	400 gm. white bread, 202 gm. meat, 737 cc. milk, 200 cc. bouillon, 75 gm. plum jam, 1,400 cc. tea, 145 gm. sugar, 175 gm. blueberries.	5	20.5	19.3	1.3	—0.1	
1187	1888	.....do	.....do	....	61.8	400 gm. white bread, 200 gm. meat, 742 cc. milk, 196 cc. bouillon, 75 gm. plum jam, 1,400 cc. tea, 148 gm. sugar, 175 gm. blueberries.	5	20.5	17.2	0.4	+2.9	Baths.
1188	1888	.....do	.....do	....	61.7	400 gm. white bread, 200 gm. meat, 737 cc. milk, 200 cc. bouillon, 75 gm. plum jam, 1,400 cc. tea, 150 gm. sugar, 175 gm. blueberries.	2	21.6	18.5	1.8	+1.3	
1189	1888	.....do	Medical student (P.)	....	62.6	403 gm. white bread, 202 gm. meat, 645 cc. milk, 200 cc. bouillon, 75 gm. plum jam, 1,350 cc. tea, 145 gm. sugar, 194 gm. blueberries.	5	20.0	19.5	1.5	—1.0	
1190	1888	.....do	.....do	....	63.0	400 gm. white bread, 206 gm. meat, 649 cc. milk, 200 cc. bouillon, 75 gm. plum jam, 1,350 cc. tea, 147 gm. sugar, 200 gm. blueberries.	5	20.1	17.2	2.0	+0.9	Do.
1191	1888	.....do	.....do	....	62.6	405 gm. white bread, 200 gm. meat, 646 cc. milk, 200 cc. bouillon, 75 gm. plum jam, 1,350 cc. tea, 150 gm. sugar, 200 gm. blueberries.	2	21.6	18.8	1.6	+1.2	
1192	1888	.....do	Physician (M.)	....	58.4	331 gm. white bread, 180 gm. meat, 657 cc. milk, 200 cc. bouillon, 50 gm. plum jam, 1,200 cc. tea, 109 gm. sugar, 200 gm. blueberries.	5	18.3	16.9	0.6	+0.8	
1193	1888	.....do	.....do	....	58.4	330 gm. white bread, 180 gm. meat, 656 cc. milk, 200 cc. bouillon, 50 gm. plum jam, 1,200 cc. tea, 110 gm. sugar, 200 gm. blueberries.	5	17.3	14.5	0.8	+2.0	Do.
1194	1888	.....do	.....do	....	58.0	330 gm. white bread, 180 gm. meat, 654 cc. milk, 200 cc. bouillon, 50 gm. plum jam, 1,200 cc. tea, 110 gm. sugar, 200 gm. blueberries.	2	14.8	16.7	0.5	—2.4	
1195	1888	.....do	Medical student (K.)	....	63.4	408 gm. white bread, 200 gm. meat, 678 cc. milk, 200 cc. bouillon, 50 gm. plum jam, 960 cc. tea, 102 gm. sugar, 232 gm. blueberries.	5	20.5	20.1	1.5	—1.1	

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1196	1888	Makovetski	Medical student (K.)	......	63.2	400 gm. white bread, 200 gm. meat, 675 cc. milk, 200 cc. bouillon, 50 gm. plum jam, 1,000 cc. tea, 105 gm. sugar, 240 gm. blueberries.	5	20.0	18.3	2.0	—0.3	Baths.
1197	1888	....do	....do	......	62.9	400 gm. white bread, 200 gm. meat, 680 cc. milk, 200 cc. bouillon, 50 gm. plum jam, 1,000 cc. tea, 105 gm. sugar, 240 gm. blueberries.	2	16.7	18.4	2.1	—3.8	
1198	1888	....do	Medcical student	......	58.6	400 gm. white bread, 180 gm. meat, 678 cc. milk, 200 cc. bouillon, 35 gm. plum jam, 800 cc. tea, 92 gm. sugar, 150 gm. blueberries.	5	19.5	16.4	1.6	+1.5	
1199	1888	....do	.... do	......	58.3	400 gm. white bread, 180 gm. meat, 676 cc. milk, 200 cc. bouillon, 35 gm. plum jam, 800 cc. tea, 92 gm. sugar, 500 gm. blueberries.	5	18.6	15.2	1.9	+1.5	
1200	1888	....do	....do	......	58.0	400 gm. white bread, 180 gm. meat, 680 cc. milk, 200 cc. bouillon, 35 gm. plum jam, 800 cc. tea, 92 gm. sugar, 150 gm. blueberries.	2	16.0	16.4	2.2	—2.6	
1201	1888	Gopadze and Vatsadze.	Soldier (T.)	......	59.6	1,024 gm. bread, 431 cc. milk, 120 gm. roast beef, 303 cc. bouillon.	3	30.1	19.6	3.1	+7.4	Before douche.
1202	1888	....do	....do	......	60.2	1,009 gm. bread, 1,005 cc. milk, 100 gm. roast beef, 303 cc. bouillon.	3	31.4	21.5	2.7	+7.2	Douche, 33°.
1203	1888	....do	....do	......	61.1	930 gm. bread, 1,699 cc. milk, 86 gm. roast beef, 364 cc. bouillon.	3	37.9	24.5	3.9	+9.5	After douche.
1204	1888	....do	....do	......	61.0	819 gm. bread, 1,565 cc. milk, 100 gm. roast beef, 364 cc. bouillon.	3	26.2	22.9	2.1	+1.2	Cold douche, 15°.
1205	1888	....do	....do	......	61.3	799 gm. bread, 1,577 cc. milk, 100 gm. roast beef, 364 cc. bouillon.	3	26.7	19.5	2.6	+4.6	After cold douche.
1206	1888	....do	....do	......	61.2	870 gm. bread, 1,513 cc. milk, 100 gm. roast beef, 364 cc. bouillon.	3	27.0	25.1	1.9	0.0	Hot douche, 40°.
1207	1888	....do	....do	......	61.4	864 gm. bread, 1,759 cc. milk, 133 gm. roast beef, 364 cc. bouillon.	3	28.9	20.9	2.9	+5.1	After hot douche.
1208	1888	....do	....do	......	61.2	914 gm. bread, 1,499 cc. milk, 150 gm. roast beef, 364 cc. bouillon.	3	30.9	30.2	2.2	—1.5	Scotch douche (from hot to cold and cold to hot).
1209	1888	....do	....do	......	61.3	749 gm. bread, 1,466 cc. milk, 117 gm. roast beef, 364 cc. bouillon.	3	27.1	21.6	2.4	+3.1	After Scotch douche.

1210	1888	....do	Soldier (S.)	......	76.5	1,014 gm. bread, 895 cc. milk, 117 gm. roast beef, 303 cc. bouillon.	3	33.4	21.1	3.6	+8.7	Before douche.
1211	1888	....do	....do	......	77.2	1,019 gm. bread, 1,152 cc. milk, 83 gm. roast beef, 303 cc. bouillon.	3	34.0	22.1	3.1	+8.8	Douche, 33°.
1212	1888	....do	....do	......	79.5	937 gm. bread, 1,577 cc. milk, 100 gm. roast beef, 364 cc. bouillon.	3	36.8	23.3	4.1	+9.4	After douche.
1213	1888	....do	....do	......	77.5	838 gm. bread, 1,456 cc. milk, 100 gm. roast beef, 364 cc. bouillon.	3	32.4	26.7	3.0	+2.7	Cold douche, 15°.
1214	1888	....do	....do	......	77.4	807 gm. bread, 1,635 cc. milk, 100 gm. roast beef, 364 cc. bouillon.	3	27.8	20.6	2.0	+5.2	After cold douche.
1215	1888	....do	....do		77.4	859 gm. bread 1,763 cc. milk, 100 gm. roast beef, 364 cc. bouillon.	3	28.1	23.9	1.7	+2.5	Hot douche, 40°.
1216	1888	....do	....do	......	77.7	855 gm. bread, 1,820 cc. milk, 150 gm. roast beef, 364 cc. bouillon.	3	29.4	19.7	2.3	+7.4	After hot douche.
1217	1888	....do	....do	......	77.5	972 gm. bread, 1,523 cc. milk, 150 gm. roast beef, 364 cc. bouillon.	3	32.2	28.8	2.3	+1.1	Scotch douche.
1218	1888	....do	....do	......	77.7	817 gm. bread, 1,254 cc. milk, 150 gm. roast beef, 364 cc. bouillon.	3	28.5	21.9	2.3	+4.3	After Scotch douche.
1219	1889	Aristov	Soldier (K.)	23	62.7	1,774 cc. milk, 293 gm. black bread, 20 gm. white bread, 199 gm. roast meat.	8	25.2	17.7	2.6	+4.9	Normal health.
1220	1889	....do	....do	23	63.9	2,299 cc. milk, 298 gm. black bread, 308 gm. white bread, 241 gm. roast meat.	8	32.5	20.3	2.6	+9.6	Normal health, enema period.
1221	1889	....do	....do	23	64.5	2,288 cc. milk, 411 gm. black bread, 193 gm. white bread, 168 gm. roast meat.	8	27.4	20.6	2.4	+4.4	Normal health.
1222	1889	....do	Soldier (K.)	23	58.5	1,732 cc. milk, 318 gm. black bread, 227 gm. white bread, 162 gm. roast meat.	7	24.2	16.6	2.8	+4.8	Do.
1223	1889	....do	....do	23	51.4	2,180 cc. milk, 370 gm. black bread, 274 gm. white bread, 214 gm. roast meat.	8	30.8	26.6	2.7	+1.5	Normal health, enema period.
1224	1889	....do	....do	23	52.0	2,846 cc. milk, 246 gm. black bread, 261 gm. white bread, 193 gm. roast meat.	7	30.6	20.6	2.7	+7.3	Normal health, nitrogen in feces = average of 7 days.
1225	1889	....do	Soldier (E.)	22	66.9	2,505 cc. milk, 829 gm. black bread, 3,150 gm. gruel, 415 gm. roast meat.	8	29.9	22.6	3.7	+3.6	Normal health. First 4 days mixed food, last 4 days gruel.
1226	1889	....do	....do	22	70.6	2,464 cc. milk, 805 gm. black bread, 3,431 gm. gruel, 386 gm. roast meat.	8	30.2	21.9	2.9	+5.4	Normal health, enema period. First 4 days gruel, last 4 days mixed food.
1227	1889	....do	....do	22	70.8	2,520 cc. milk, 802 gm. black bread, 3,100 gm. gruel, 257 gm. roast meat.	6	25.9	21.3	3.3	+1.3	Normal health. First 3 days mixed food, last 3 days gruel.
1228	1889	....do	Soldier (K.)	22	68.5	2,500 cc. milk, 887 gm. black bread, 3,150 gm. gruel, 415 gm. roast meat.	8	30.2	19.0	5.9	+5.3	Normal health. First 4 days mixed food, last 4 days gruel.
1229	1889	....do	....do	22	62.9	2,470 cc. milk, 871 gm. black bread, 3,431 gm. gruel, 248 gm. roast meat.	8	29.5	18.6	4.9	+6.0	Normal health, enema period. First 4 days gruel, last 4 days mixed food.
1230	1889	....do	....do	22	63.8	2,483 cc. milk, 817 gm. black bread, 3,433 gm. gruel, 257 gm. roast meat.	6	25.9	18.8	5.7	+1.4	Normal health. First 3 days mixed food, last 3 days gruel.

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1231	1889	Aristov	Soldier (F.)	24	52.1	1,375 cc. milk, 1,590 gm. gruel, 842 gm. egg	6	13.3	9.7	0.6	+ 3.0	Constipation. First 3 days gruel, third, fifth, and sixth days milk and eggs.
1232	1889	do	do	24	51.6	638 cc. milk, 1,332 gm. gruel, 1,795 gm. egg	7	15.2	11.3	1.2	+ 2.7	Constipation, enema period. First 2 and last 3 days milk and gruel, third and fourth days eggs.
1233	1889	do	do	24	51.6	1,067 cc. milk, 1,525 gm. gruel, 1,863 gm. egg	5	12.6	11.0	1.0	+ 0.6	Constipation. Eggs 1 day, milk 1 day, gruel 1 day, milk and eggs 1 day, milk and gruel 1 day. Nitrogen in urine = average of 8 days.
1234	1889	do	Soldier (Ye.)	58	50.5	1,375 cc. milk, 785 gm. gruel, 842 gm. egg	6	11.0	6.4	0.6	+ 4.0	Constipation, enema period. In Nos. 1234–1257 all the foods were seldom taken on the same day. Averages were determined by dividing total quantity by days on which it was consumed.
1235	1889	do	do	58	50.4	625 cc. milk, 1,612 gm. gruel, 1,795 gm. egg	7	15.0	9.7	0.8	+ 4.5	Constipation, enema period.
1236	1889	do	do	58	50.4	1,067 cc. milk, 1,525 gm. gruel, 908 gm. egg	8	12.6	10.3	0.5	+ 1.8	Do.
1237	1889	do	Soldier (W.)	22	65.5	1,504 cc. milk, 401 gm. manna, 2,400 gm. egg, 401 gm. white bread.	6	22.9	13.7	1.5	+ 7.7	Normal health.
1238	1889	do	do	22	66.3	2,500 cc. milk, 3,157 gm. manna, 2,960 gm. egg, 399 gm. white bread, 795 gm. black bread.	7	26.5	19.5	2.3	+ 4.7	Normal health, enema period.
1239	1889	do	do	22	67.7	3,000 cc. milk, 3,150 gm. manna, 2,207 gm. egg, 814 gm. black bread, 380 gm. white bread.	8	27.5	20.3	2.4	+ 4.8	Normal health.
1240	1889	do	Soldier (Tz.)	22	43.0	1,473 cc. milk, 482 gm. manna gruel, 2,115 gm. egg, 288 gm. white bread, 200 gm. black bread.	7	18.1	11.4	2.3	+ 4.4	Do.

1241	1889	.....do	.....do	22	44.0	2,500 cc. milk, 1,732 gm. manna gruel, 2,180 gm. egg, 339 gm. white bread, 200 gm. black bread.	7	19.3	11.8	2.8	+ 4.7	Normal health, enema period.
1242	1889	.....do	.....do	22	44.0	2,525 cc. milk, 2,045 gm. manna gruel, 2,010 gm. egg, 314 gm. white bread, 200 gm. black bread.	7	21.5	11.7	3.5	+ 6.3	Normal health.
1243	1889	.....do	Soldier (E.)	22	70.8	1,563 cc. milk, 2,975 gm. manna gruel, 3,400 gm. egg, 400 gm. white bread, 800 gm. black bread.	7	29.0	17.3	2.9	+ 8.8	Do.
1244	1889	.....do	.....do	22	70.5	2,500 cc. milk, 2,967 gm. manna gruel, 2,930 gm. egg, 467 gm. white bread, 800 gm. black bread.	8	29.5	21.9	3.1	+ 4.5	Normal health, enema period.
1245	1889	.....do	.....do	22	70.5	1,758 cc. milk, 2,565 gm. manna gruel, 1,378 gm. egg, 419 gm. white bread, 815 gm. black bread.	7	20.7	15.0	1.8	+ 3.9	Normal health.
1246	1889	.....do	Sailor (Sh.)	21	73.3	1,688 cc. milk, 2,541 gm. manna gruel, 3,400 gm. egg, 384 gm. white bread, 620 gm. black bread.	7	26.9	18.1	1.2	+ 7.6	Constipation.
1247	1889	.....do	.....do	21	73.7	2,500 cc. milk, 2,800 gm. manna gruel, 2,898 gm. egg, 473 gm. white bread, 675 gm. black bread.	8	28.6	20.4	2.0	+ 6.2	Constipation, enema period.
1248	1889	.....do	.....do	21	74.3	2,500 cc. milk, 2,850 gm. manna gruel, 2,592 gm. egg, 403 gm. white bread, 825 gm. black bread.	7	26.3	14.3	2.3	+ 9.7	Constipation.
1249	1889	.....do	Soldier (Z.)	37	46.2	1,308 cc. milk, 1,783 gm. manna gruel, 1,700 gm. egg, 399 gm. white bread, 635 gm. black bread.	7	19.8	9.6	2.9	+ 7.3	Normal health.
1250	1889	.....do	.....do	37	46.5	1,700 cc. milk, 1,820 gm. manna gruel, 1,915 gm. egg, 431 gm. white bread, 580 gm. black bread.	8	20.8	10.7	4.2	+ 5.9	Normal health, enema period.
1251	1889	.....do	.....do	37	47.1	1,750 cc. milk, 2,000 gm. manna gruel, 2,000 gm. egg, 395 gm. white bread, 610 gm. black bread.	7	18.2	10.2	2.8	+ 5.2	Normal health.
1252	1889	.....do	Soldier (M.)	30	65.5	2,583 cc. milk, 2,367 gm. gruel, 2,200 gm. egg, 458 gm. white bread, 820 gm. black bread.	7	24.5	11.5	2.7	+10.3	Do.
1253	1889	.....do	.....do	30	66.0	2,050 gm. gruel, 2,350 gm. egg, 369 gm. white bread.	4	26.2	8.8	2.9	+14.5	Normal health, enema period.
1254	1889	.....do	Soldier (S.)	23	70.5	2,683 cc. milk, 2,367 gm. gruel, 2,445 gm. egg, 466 gm. white bread, 820 gm. black bread.	7	25.1	13.5	4.2	+ 7.4	Normal health.
1255	1889	.....do	.....do	23	70.8	2,050 gm. gruel, 2,350 gm. egg, 396 gm. white bread.	4	26.0	13.2	2.2	+10.6	Normal health, enema period.
1256	1889	.....do	Soldier (O.)	23	58.6	2,585 cc. milk, 2,300 gm. gruel, 2,200 gm. egg, 460 gm. white bread, 820 gm. black bread.	7	24.3	12.7	3.0	+ 8.6	Normal health.
1257	1889	.....do	.....do	23	58.8	2,000 gm. gruel, 1,625 gm. egg, 396 gm. white bread.	4	21.9	15.2	1.6	+ 5.1	Normal health, enema period.
1258	1890	Zavadski	Hospital servant (S.)	21	60.9	561 gm. bread, 196 gm. meat, 480 cc. bouillon, 1,920 cc. tea and water.	4	23.4	19.8	2.2	+ 1.4	
1259	1890	.....do	.....do	21	61.0	667 gm. bread, 225 gm. meat, 480 cc. bouillon, 1,920 cc. tea and water.	4	24.7	21.5	2.3	+ 0.9	Baths.
1260	1890	.....do	.....do	21	60.8	601 gm. bread, 200 gm. meat, 480 cc. bouillon, 1,920 cc. tea and water.	4	24.2	20.0	3.0	+ 1.2	

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1261	1890	Zavadski	Hospital servant (M.).	25	58.3	920 gm. bread, 200 gm. meat, 520 cc. bouillon, 2,730 cc. tea and water.	4	30.4	25.0	3.0	+ 2.4	
1262	1890	....do	....do	25	58.6	975 gm. bread, 237 gm. meat, 520 cc. bouillon, 2,730 cc. tea and water.	4	31.5	27.0	2.4	+ 2.1	Baths.
1263	1890	....do	....do	25	58.6	900 gm. bread, 200 gm. meat, 520 cc. bouillon, 2,730 cc. tea and water.	4	29.2	23.6	2.6	+ 3.0	
1264	1890	....do	Hospital servant (V.)	23	67.4	813 gm. bread, 200 gm. meat, 440 cc. bouillon, 2,090 cc. tea and water.	4	28.4	23.2	2.7	+ 2.5	
1265	1890	....do	....do	23	67.7	950 gm. bread, 250 gm. meat, 440 cc. bouillon, 2,090 cc. tea and water.	4	29.3	25.4	2.0	+ 1.9	Do.
1266	1890	....do	....do	23	67.6	800 gm. bread, 200 gm. meat, 440 cc. bouillon, 2,090 cc. tea and water	4	27.4	23.7	2.1	+ 1.6	
1267	1890	....do	Student (V.)	21	65.6	600 gm. bread, 210 gm. meat, 1,000 cc. bouillon, 1,440 cc. tea and water.	4	25.7	19.7	2.7	+ 3.3	
1268	1890	....do	....do	21	65.8	655 gm. bread, 245 gm. meat, 1,000 cc. bouillon, 1,440 cc. tea and water.	4	29.3	24.5	2.7	+ 2.1	Do.
1269	1890	....do	....do	21	65.7	600 gm. bread, 213 gm. meat, 1,000 cc. bouillon, 1,440 cc. tea and water.	4	27.7	21.1	2.8	+ 3.8	
1270	1890	....do	Physicians' assistant (F.).	21	60.6	600 gm. bread, 199 gm. meat, 1,000 cc. bouillon, 1,750 cc. tea and water.	4	25.6	21.8	1.2	+ 2.6	
1271	1890	....do	....do	21	61.0	620 gm. bread, 212 gm. meat, 1,000 cc. bouillon, 1,750 cc. tea and water.	4	26.8	23.6	1.4	+ 1.8	Do.
1272	1890	....do	....do	21	61.0	600 gm. bread, 186 gm. meat, 1,000 cc. bouillon, 1,750 cc. tea and water.	4	24.0	20.5	1.5	+ 2.0	
1273	1890	Nechayev	Physician (V.)	30	59.5	400 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 1,644 cc. tea.	4	21.1	18.7	2.6	— 0.2	
1274	1890	....do	....do	30	59.5	359 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 1,740 cc. tea.	4	20.4	19.7	2.6	— 1.9	Salt baths.
1275	1890	....do	....do	30	59.0	373 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 1,733 cc. tea.	4	19.0	18.0	1.6	— 0.6	
1276	1890	....do	Physician (S.)	34	67.6	456 gm. bread, 400 gm. meat, 70 gm. butter, 790 cc. milk, 1,536 cc. tea.	4	22.0	17.0	2.6	+ 2.4	
1277	1890	....do	....do	34	67.6	481 gm. bread, 400 gm. meat, 70 gm. butter, 718 cc. milk, 1,819 cc. tea.	4	21.8	20.1	2.3	— 0.6	Do.
1278	1890	....do	....do	34	67.5	498 gm. bread, 400 gm. meat, 70 gm. butter, 716 cc. milk, 1,836 cc. tea.	4	19.9	16.8	1.9	+ 1.2	

1279	1890	.....do	Nurse (R.)	25	51.5	400 gm. bread, 400 gm. meat, 70 gm. buttor, 720 cc. milk, 1,585 cc. tea.	4	21.0	16.5	2.7	+ 1.8	
1280	1890	.....do	.... do	25	51.3	400 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 1,506 cc. tea.	4	20.9	16.3	2.6	+ 2.0	Do.
1281	1890	.....do	.....do	25	51.6	400 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 1,185 cc. tea.	4	19.0	15.8	1.9	+ 1.3	
1282	1890	.....do	Nurse (Ya.)	20	60.8	500 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 2,291 cc. tea.	4	22.3	17.5	3.6	+ 1.2	
1283	1890	.....do	.....do	20	60.4	500 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 1,939 cc. tea.	4	22.1	17.6	2.6	+ 1.9	Do.
1284	1890	.....do	.....do	20	60.8	500 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 1,883 cc. tea.	4	19.9	17.1	1.6	+ 1.2	
1285	1890	.....do	Soldier (A.)	25	62.8	800 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 2,296 cc. tea.	4	25.9	19.1	3.9	+ 2.9	
1286	1890	.....do	.....do	25	62.8	800 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 2,340 cc. tea.	4	23.2	17.9	2.6	+ 2.7	Do.
1287	1890	.....do	.....do	25	62.9	800 gm. bread, 400 gm. meat, 70 gm. butter, 720 cc. milk, 2,876 cc. tea.	4	22.4	18.8	2.6	+ 1.0	
1288	1891	Voskresenski	Stndent (Ya.)	21	66.5	600 gm. bread, 400 gm. meat, 460 cc. bouillon, 1,000 cc. milk, 1,643 cc. water.	4	29.2	20.9	1.7	+ 6.6	
1289	1891	.....do	.....do	21	66.0	600 gm. bread, 400 gm. meat, 460 cc. bouillon, 1,000 cc. milk, 1,380 cc. water.	4	35.2	21.5	1.9	+11.8	Aromatic baths.
1290	1891	.....do	.....do	21	65.4	600 gm. bread, 400 gm. meat, 460 cc. bouillon, 1,000 cc. milk, 1,552 cc. water.	4	33.4	24.4	2.5	+ 6.5	
1291	1891	.....do	Nurse (Ya.)	21	60.8	600 gm. bread, 400 gm. meat, 460 cc. bouillon, 1,000 cc. milk, 1,205 cc. water.	4	29.2	23.5	1.6	+ 4.1	
1292	1891	.....do	.....do	21	60.6	600 gm. bread, 400 gm. meat, 460 cc. bouillon, 1,000 cc. milk, 1,437 cc. water	4	35.2	24.5	1.4	+ 9.3	Do.
1293	1891	.....do	.....do	21	60.5	600 gm. bread, 400 gm. meat, 460 cc. bouillon, 1,000 cc. milk, 1,495 cc. water.	4	33.4	26.1	2.7	+ 4.6	
1294	1891	.....do	Nurse (Shch.)	19	47.4	600 gm. bread, 400 gm. meat, 480 cc. bouillon, 1,000 cc. milk, 1,152 cc. water.	4	29.2	20.4	4.2	+ 4.6	
1295	1891	.....do	.....do	19	47.6	600 gm. bread, 400 gm. meat, 480 cc. bouillon, 1,000 cc. milk, 1,362 cc. water.	4	35.2	19.1	3.0	+13.1	Do.
1296	1891	.....do	.....do	19	47.6	600 gm. bread, 400 gm. meat, 480 cc. bouillon, 1,000 cc. milk, 1,234 cc. water.	4	33.5	23.2	3.4	+ 6.9	
1297	1891	.....do	Hospital servant (Th.).	24	61.2	700 gm. bread, 400 gm. meat, 375 cc. bouillon, 1,000 cc. milk, 1,745 cc. water.	4	31.6	20.3	2.7	+ 8.6	
1298	1891	.....do	.....do	24	62.1	700 gm. bread, 400 gm. meat, 400 cc. bouillon, 1,000 cc. milk, 1,500 cc. water.	4	35.4	15.9	1.2	+18.3	Do.
1299	1891	.....do	.....do	24	62.1	700 gm. bread, 400 gm. meat, 200 cc. bouillon, 1,000 cc. milk, 1,350 cc. water.	4	32.1	15.7	1.6	+14.8	
1300	1891	.....do	Hospital servant (N.).	23	55.5	700 gm. bread, 410 gm. meat, 465 cc. bouillon, 1,000 cc. milk, 882 cc. water.	4	31.8	20.7	3.2	+ 7.9	
1301	1891	.....do	.....do	23	55.8	700 gm. bread, 400 gm. meat, 375 cc. bouillon, 1,000 cc. milk, 1,250 cc. water.	4	35.3	17.5	3.2	+14.6	Do.
1302	1891	.....do	.....do	23	56.0	700 gm. bread, 400 gm. meat, 300 cc. bouillon, 1,000 cc. milk, 1,500 cc. water.	4	32.3	19.4	2.2	+10.7	
1303	1891	.....do	Hospital scrvant (Th.).	24	60.2	630 gm. bread, 400 gm. meat, 407 cc. bouillon, 1,000 cc. milk, 3,315 cc. water.	4	38.2	21.6	2.2	+14.4	
1304	1891	.....do	.....do	24	60.4	625 gm. bread, 400 gm. meat, 377 cc. bouillon, 1,000 cc. milk, 3,625 cc. water.	4	32.9	25.7	2.9	+ 4.3	Do.

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject: Occupation.	Subject: Age.	Subject: Weight.	Food per day.	Duration.	Nitrogen: In food.	Nitrogen: In urine.	Nitrogen: In feces.	Nitrogen: Gain (+) or loss (−).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1305	1891	Voskresenski	Hospital servant (Th.).	24	60.4	600 gm. bread, 400 gm. meat, 400 cc. bouillon, 1,000 cc. milk, 2,312 cc. water.	4	34.0	19.2	3.9	+10.9	Aromatic baths.
1306	1891	.....do	Nurse (U.)	20	58.7	50) gm. bread, 400 gm. meat, 377 cc. bouillon, 1,000 cc. milk, 1,200 cc. water.	4	36.9	23.4	1.9	+11.6	
1307	1891	.....do	.....do	20	59.0	500 gm. bread, 400 gm. meat, 400 cc. bouillon, 1,000 cc. milk, 1,200 cc. water.	4	33.9	19.9	2.9	+11.1	Do.
1308	1891	.....do	.....do	20	58.4	.....do	4	32.5	20.5	2.8	+ 9.2	
1309	1891	.....do	Nurse (Sh.)	20	67.3	575 gm. bread, 400 gm. meat, 720 cc. bouillon, 1,000 cc. milk, 990 cc. water.	4	38.4	28.7	2.5	+ 7.2	
1310	1891	.....do	.....do	20	67.2	583 gm. bread, 400 gm. meat, 705 cc. bouillon, 1,000 cc. milk, 1,305 cc. water.	4	32.8	30.5	3.0	− 0.7	Do.
1311	1891	.....do	.....do	20	66.5	600 gm. bread, 400 gm. meat, 720 cc. bouillon, 1,000 cc. milk, 900 cc. water.	4	34.6	28.0	1.9	+ 4.7	
1312	1891	Velitchkine	Nurse (Ch.)	21	59	600 gm. bread, 300 gm. meat, 1,000 cc. milk, 60 gm. butter, 1,200 cc. water, 4 gm. salt.	5	23.3	18.4	2.1	+ 2.8	
1313	1891	.....do	.....do	21	59	Food samo as No. 1312, with 1,320 cc. water.	5	24.0	20.6	1.4	+ 2.0	Hot-air baths.
1314	1891	.....do	.....do	21	59	Food same as No. 1312, with 1,200 cc. water.	5	23.9	19.3	2.0	+ 2.6	
1315	1891	.....do	Nurse (V.)	21	67	800 gm. bread, 350 gm. meat, 1,000 cc. milk, 60 gm. butter, 2,020 cc. water, 4 gm. salt.	5	27.4	21.0	2.0	+ 4.4	
1316	1891	.....do	.....do	21	68	Food same as No. 1315, with 2,160 cc. water.	5	28.5	23.0	1.4	+ 4.1	Do.
1317	1891	.....do	.....do	21	68	Food same as No. 1315, with 1,890 cc. water.	5	28.5	21.8	1.7	+ 5.0	
1318	1891	.....do	Physician (S.)	38	89	800 gm. bread, 350 gm. meat, 600 cc. milk, 70 gm. butter, 2,480 cc. water, 4 gm. salt.	5	28.8	23.8	2.0	+ 3.0	
1319	1891	.....do	.....do	38	89	Food same as No. 1318, with 2,560 cc. water.	5	29.9	26.6	1.3	+ 2.0	Do.
1320	1891	.....do	.....do	38	89	Food same as No. 1318, with 2,480 cc. water.	5	29.1	24.3	1.6	+ 4.2	
1321	1891	.....do	Observer	32	57	550 gm. bread, 300 gm. meat, 600 cc. milk, 60 gm. butter, 1,600 cc. water, 4 gm. salt.	5	22.9	20.2	1.3	+ 1.4	
1322	1891	.....do	.....do	32	58	.....do	5	23.7	22.0	0.9	+ 0.8	Do.
1323	1891	.....do	.....do	32	58	.....do	5	22.9	19.3	1.3	+ 2.3	
1324	1891	.....do	Nurse (K.)	20	76	800 gm. bread, 350 gm. meat, 800 cc. milk, 70 gm. butter, 1,400 cc. water, 3 gm. salt.	5	29.9	24.4	1.8	+ 3.7	
1325	1891	.....do	.....do	20	76	.....do	5	31.0	26.8	1.1	+ 3.1	Do.
1326	1891	.....do	.....do	20	77	.....do	5	30.1	23.1	1.3	+ 5.7	
1327	1891	.....do	Nurse (S.)	18	67	Food same as No. 1324, with 1,600 cc. water.	5	29.8	21.8	1.9	+ 6.1	
1328	1891	.....do	.....do	18	66	.....do	5	30.9	25.1	1.3	+ 4.5	Do.
1329	1891	.....do	.....do	18	67	.....do	5	30.1	22.1	1.6	+ 6.4	

1330	1892	Köstlin	Observer	25	57	520 gm. black bread, 250 gm. lean meat, 80 gm. cervalat sausage, 100 gm. butter, 75 gm. milk, 14 gm. sugar, 1,200 cc. beer, 500 cc. coffee, 250 cc. water.	3	17.6	16.4	(1.5)	—0.3	
1331	1892	do	do	25		do	1	17.6	15.0	(1.5)	+ 1.1	Warm salt bath.
1332	1892	do	do	25		do	1	17.6	14.4	(1.5)	+ 1.7	Day following No. 1331.
1333	1892	do	do	25		do	3	17.6	16.4	(1.5)	— 0.3	
1334	1892	do	do	25		do	1	17.6	15.0	(1.5)	+ 1.1	Warm salt bath.
1335	1892	do	do	25		do	5	17.6	15.5	(1.5)	+ 0.6	Warm salt bath on 1 day.
1336	1892	do	do	25		do	1	17.6	14.1	(1.5)	+ 2.0	Warm salt bath.
1337	1892	do	do	25		do	2	17.6	15.1	(1.5)	+ 1.0	Two days following No. 1336.
1338	1892	do	do	25		do	1	17.6	13.7	(1.5)	+ 2.4	Warm salt bath.
1339	1892	do	do	25		do	5	17.6	14.3	(1.5)	+ 1.8	
1340	1892	Klingmuller (reported by Köstlin).	Observer			do	3	17.6	14.8	(1.5)	+ 1.3	
1341	1892	do	do			do	1	17.6	13.4	(1.5)	+ 2.7	Do.
1342	1892	do	do			do	1	17.6	14.2	(1.5)	+ 1.9	Day following No. 1340.
1343	1892	do	do			do	2	17.6	15.4	(1.5)	+ 0.7	
1344	1892	do	do			do	1	17.6	12.9	(1.5)	+ 3.2	Warm salt bath.
1345	1892	do	do			do	1	17.6	13.1	(1.5)	+ 2.0	Day following No. 1344.
1346	1892	Formanek	Observer	22	71.0	400 gm. meat, 100 gm. Emmenthaler cheese, bread from 144 gm. flour, 100 gm. rice, 120 gm. butter, 1,500 cc. beer, 0.3 gm. tea, 20 gm. sugar, 5 gm. salt, 400 cc. water.	8	22.1	20.9		+ 1.2	
1347	1892	do	do	22		do	1	22.1	21.3		+ 0.8	Hot air bath (81°), steam bath (51°), and lukewarm douche.
1348	1892	do	do	22		do	4	22.1	21.4		+ 0.7	
1349	1892	do	Medical student	23	76.0	200 gm. sausage. Cheese, etc., as in No. 1346.	8	16.3	15.7		+ 0.6	
1350	1892	do	do	23		do	2	16.3	16.3		0.0	Hot air bath (1 day) and steam bath (58°).
1351	1892	do	do	23		do	2	16.3	15.4		+ 0.9	
1352	1892	do	Medical student	22	65.5	200 gm. sausage, 150 gm. Emmenthaler cheese, 50 gm. rice, bread from 144 gm. flour, 1,500 cc. beer, 0.3 gm. tea, 20 gm. sugar, 5 gm. salt, 400 cc. water.	9	18.1	17.2		+ 0.9	
1353	1892	do	do	22		do	3	18.1	18.3		— 0.2	On first day one tub bath, on second day two.
1354	1892	do	do	22		do	2	18.1	19.0		— 0.9	
1355	1893	Troïtsky	Soldier	23	72	1,000 gm. bread, 100 gm. rice, 30 gm. oil, 5,765 cc. water and tea.	3	12.8	14.3	5.2	— 6.7	Mud bath.
1356	1893	do	do	23		1,000 gm. bread, 100 gm. rice, 30 gm. oil, 6,708 cc. water and tea.	3	14.3	10.0	4.5	— 0.2	Mud bath (not full strength).
1357	1893	do	do	23		1,000 gm. bread, 100 gm. rice, 30 gm. oil, 6,277 cc. water.	3	15.1	12.2	4.7	— 1.8	
1358	1894	Formanek	Medical student	24	60	200 gm. sausage, 100 gm. Emmenthaler cheese, bread from 144 gm. flour, 100 gm. rice, 100 gm. butter, 1,400 cc. beer, 20 gm. sugar, 5 gm. salt, 350 cc. water.	14	15.8	13.4	1.5	+ 0.9	

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (−).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1359	1894	Formanek	Medical student	24	......	200 gm. sausage, 100 gm. Emmenthaler cheese, bread from 144 gm. flour, 100 gm. rice, 100 gm. butter, 1,400 cc. beer, 20 gm. sugar, 5 gm. salt, 350 cc. water.	1	15.8	12.0	1.6	+2.2	Cold bath.
1360	1894	do	do	24	......	do	4	15.8	12.9	1.6	+1.3	
1361	1894	do	do	24	......	do	3	15.8	14.5	1.9	−0.6	Two cold baths daily (14.1-14.9°).
1362	1894	do	do	24	......	do	3	15.8	13.4	1.6	+0.8	
1363	1894	do	do	24	......	do	3	15.8	14.5	1.9	−0.6	On first day, one cold bath (14.2°); on remaining days, two cold baths (14.1-15.1°)
1364	1894	do	do	24	......	do	3	15.8	13.5	1.6	+0.7	
1365	1894	Topp	Observer	......	......	270 gm. white bread, 250 gm. lean meat, 70 gm. butter, 30 gm. bacon, 70 gm. skim milk cheese, 1,000 cc. milk, 1,200 cc. beer. 250 cc. water (140.1 gm. fat, 281.8 gm. carbohydrates, 60 cc. alcohol).	13	22.1	21.4	(0.6)	+0.1	
1366	1894	do	do	......	......	do	1	22.1	22.1	(0.6)	−0.6	Hot bath (46°).
1367	1894	do	do	......	......	do	1	22.1	22.0	(0.6)	−0.5	Hot bath (46.5°).
1368	1894	do	do	......	......	do	1	22.1	22.4	(0.6)	−0.9	Two hot baths (42°).
1369	1894	do	do	......	......	do	......	22.1	22.2	(0.6)	−0.7	Average of Nos. 1366-1368.
1370	1894	do	do	......	......	do	5	22.1	21.4	(0.6)	+0.1	
1371	1894	do	do	......	......	do	1	22.1	22.3	(0.6)	−0.8	Two hot baths (41°).
1372	1896	Bezrodnov	Hospital servant (I.).	23	63.6	400 gm. meat, 600 gm. bread, 925 gm. milk, 80 gm. sugar, 100 gm. butter, 1,625 cc. water.	4	26.0	21.5	2.5	+2.0	
1373	1896	do	do	23	64.3	400 gm. meat, 600 gm. bread, 975 gm. milk, 80 gm. sugar, 100 gm. butter, 1,500 cc. water.	4	26.2	22.5	2.3	+1.4	Hot sand baths.
1374	1896	do	do	23	63.7	400 gm. meat, 600 gm. bread, 1,000 gm. milk, 80 gm. sugar, 97 gm. butter, 1,250 cc. water.	4	26.1	23.8	1.6	+0.7	
1375	1896	do	Hospital nurse (Kh.).	21	63.0	300 gm. meat, 700 gm. bread, 1,000 gm. milk, 120 gm. sugar, 100 gm. butter, 1,300 cc. water.	4	24.3	18.3	1.4	+4.6	
1376	1896	do	do	21	63.1	300 gm. meat, 650 gm. bread, 1,000 gm. milk, 120 gm. sugar, 100 gm. butter, 1,800 cc. water.	4	23.8	18.4	1.8	+3.6	Do.

1377	1896	....do	....do	21	63.2	300 gm. meat, 700 gm. bread, 1,000 gm. milk, 120 gm. sugar, 100 gm. butter, 1,900 cc. water.	4	24.9	20.5	1.4	+3.0	
1378	1896	....do	Hospital servant	28	55.3	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 1,560 cc. water.	4	18.7	13.9	1.7	+3.1	
1379	1896	....do	....do	28	54.9	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 1,650 cc. water.	4	18.4	13.7	2.7	+2.0	Do.
1380	1896	....do	....do	28	55.4	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 1,470 cc. water.	4	18.2	13.7	3.2	+1.3	
1381	1896	....do	Hospital servant (M.).	22	61.8	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 1,850 cc. water.	4	18.7	14.2	1.9	+2.6	
1382	1896	....do	....do	22	61.7	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 1,950 cc. water.	4	18.4	15.0	2.2	+1.2	Do.
1383	1896	....do	....do	22	61.6	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 1,850 cc. water.	4	18.2	15.1	2.4	+0.7	
1384	1896	....do	Hospital servant (Z.).	22	65.7	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 2,000 cc. water.	4	18.7	13.4	2.7	+2.6	
1385	1896	....do	....do	22	65.9	250 gm. meat, 800 gm. bread, 500 gm. milk, 100 gm. sugar, 60 gm. butter, 1,850 cc. water.	4	18.4	13.9	2.9	+1.6	Do.
1386	1896	....do	....do	22	65.3	....do	4	18.2	14.5	2.3	+1.4	
1387	1896	....do	Soldier (Ya.)	24	60.9	200 gm. meat, 600 gm. bread, 700 gm. milk, 80 gm. sugar, 100 gm. butter, 2,350 cc. water.	4	20.6	17.5	2.0	+1.1	
1388	1896	....do	....do	24	61.2	200 gm. meat, 700 gm. bread, 700 gm. milk, 80 gm. sugar, 100 gm. butter, 2,463 cc. water.	4	21.1	16.0	2.7	+2.4	Do.
1389	1896	....do	....do	24	60.9	200 gm. meat, 700 gm. bread, 700 gm. milk, 80 gm. sugar, 100 gm. butter, 2,250 cc. water.	4	21.1	17.1	2.0	+2.0	
1390	1896	....do	Soldier (F.)	24	74.3	200 gm. meat, 600 gm. bread, 700 gm. milk, 80 gm. sugar, 100 gm. butter, 2,450 cc. water,	4	20.6	15.8	1.9	+2.9	
1391	1896	....do	....do	24	72.9	200 gm. meat, 600 gm. bread, 700 gm. milk, 80 gm. sugar, 100 gm. butter, 2,150 cc. water.	4	19.5	16.6	1.4	+1.5	Do.
1392	1896	....do	....do	24	73.3	200 gm. meat, 600 gm. bread, 700 gm. milk, 80 gm. sugar, 100 gm. butter, 1,750 cc. water.	4	19.8	16.4	1.3	+2.1	
1393	1896	....do	Hospital nurse (K.).	21	78.0	250 gm. meat, 800 gm. bread, 700 gm. milk, 120 gm. sugar, 100 gm. butter, 1,800 cc. water.	4	25.9	19.2	1.3	+5.4	
1394	1896	....do	....do	21	78.6	250 gm. meat, 800 gm. bread, 700 gm. milk, 120 gm. sugar, 100 gm. butter, 1,750 cc. water.	4	23.5	22.1	1.5	—0.1	Do.

TABLE 12.—*Experiments to determine the effect of baths and enemas*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1395	1896	Bezrodnov	Hospital nurse (K.).	21	78.7	250 gm. meat, 800 gm. bread, 700 gm. milk, 120 gm. sugar, 100 gm. butter, 1,813 cc. water.	4	24.3	21.3	0.9	+2.1	

Nos. 1084-1086. Influence of fresh-water and mineral baths of Staraia-Russa, on the metabolism and assimilation of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1886, p. 32. Nos. 1087–1089. Ibid., p. 34. Nos. 1090–1092. Ibid., p. 36. Nos. 1093–1095. Ibid., p. 38. Nos. 1096–1098. Influence of friction in cold, wet blankets on the metabolism and assimilation of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1887, Table 1. Nos. 1099–1101. Ibid., Table 2. Nos. 1102–1104. Ibid., Table 3. Nos. 1105–1107. Ibid., Table 4. Nos. 1108–1110. The metabolism of nitrogen in man in its qualitative and quantitative relations. Inaug. Diss. (Russian), St. Petersburg, 1887, Table 1. Nos. 1111–1113. Ibid., Table 2. Nos. 1114–1116. Ibid., Table 3. Nos. 1117–1119. Ibid., Table 4. Nos. 1120–1122. Ibid., Table 5. Nos. 1123–1125. Ibid., Table 6. Nos. 1126–1128. Ibid., Table 7. Nos. 1129–1132. Ibid., Table 8. Nos. 1133–1137. Ibid., Table 9. Nos. 1138–1143. Vrach, 8, p. 209. Nos. 1144-1146. The influence of hot-air baths on the metabolism and assimilation of nitrogen in healthy persons and those with nephritis. Inaug. Diss. (Russian), St. Petersburg, 1887, p. 43. Nos. 1147–1149. Ibid., p. 44. Nos. 1150–1152. Ibid., p. 45. Nos. 1153–1155. Ibid., p. 46. Nos. 1156–1158. Ibid., p. 47. Nos. 1159–1161. Ibid., p. 48. Nos. 1162–1164. Influence of cold affusions on the metabolism and assimilation of nitrogen, the pulse, breathing, skin, and internal temperature, losses by the skin and lungs and arterial blood pressure in healthy man. Inaug. Diss. (Russian), St. Petersburg, Table 1. Nos. 1165–1167, Ibid., Table 2. Nos. 1168–1170. Ibid., Table 3. Nos. 1171–1173. Ibid., Table 4. Nos. 1174–1176. Ibid., Table 5. Nos. 1177–1179. Ibid., Table 6. Nos. 1180–1182. Ibid., Table 7. Nos. 1183–1185. Ibid., Table 8. Nos. 1186–1188. The influence of Russian baths on the metabolism of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1888, p. 46, Table 1. Nos. 1189–1191. Ibid., p. 48, Table 2. Nos. 1192–1194. Ibid., p. 50, Table 3. Nos. 1195–1197. Ibid., p. 52, Table 4. Nos. 1198–1200. Ibid., p. 54, Table 4. Nos. 1201–1218. Vrach, 9, pp. 547, 548. Nos. 1219–1221. The assimilation of protein when enemas are taken. Inaug. Diss. (Russian), St. Petersburg, 1889, Table 1. Nos. 1222–1224. Ibid., Table 2. Nos. 1225–1227. Ibid., Table 3. Nos. 1228–1230. Ibid., Table 4. Nos. 1231–1233. Ibid., Table 5. Nos. 1234–1236. Ibid., Table 6. Nos. 1237–1239. Ibid., Table 7. Nos. 1240–1242. Ibid., Table 8. Nos. 1243–1245. Ibid., Table 9. Nos. 1246–1248. Ibid., Table 10. Nos. 1249–1251. Ibid., Table 11. Nos. 1252, 1253. Ibid., Table 12. Nos. 1254, 1255. Ibid., Table 13. Nos. 1256, 1257. Ibid., Table 14. Nos. 1258–1260. The influence of tepid baths on the metabolism and assimilation of nitrogen in healthy man. Inaug. Diss. (Russian). St. Petersburg, 1890, Table 1. Nos. 1261–1263. Ibid., Table 2. Nos. 1264–1266. Ibid., Table 3. Nos. 1267–1269. Ibid., Table 4. Nos. 1270–1272. Ibid., Table 5. Nos. 1273–1275. The influence of salt baths on the metabolism and assimilation of protein in healthy man. Inaug. Diss. (Russian), St. Petersburg, 1890, Table 1. Nos. 1276–1278. Ibid., Table 2. Nos. 1279–1281. Ibid., Table 3. Nos. 1282–1284. Ibid., Table 4. Nos. 1285–1287. Ibid., Table 5. Nos. 1288–1290. The influence of aromatic baths on the metabolism and assimilation of nitrogen in healthy man. Inaug. Diss. (Russian), St. Petersburg, 1891, Table 1. Nos. 1291–1293. Ibid., Table 2. Nos. 1294–1296. Ibid., Table 3. Nos. 1297–1299. Ibid., Table 4. Nos. 1300–1302. Ibid., Table 5. Nos. 1303–1305. Ibid., Table 6. Nos. 1306–1308. Ibid., Table 7. Nos. 1309–1311. Ibid., Table 8. Nos. 1312–1314. The influence of hot-air baths on the metabolism and assimilation of nitrogen, and the losses through the kidneys and lungs in healthy man. Inaug. Diss. (Russian), St. Petersburg, 1891, Table 1. Nos. 1315–1317. Ibid., Table 2. Nos. 1318–1320. Ibid., Table 3. Nos. 1321–1323. Ibid., Table 4. Nos. 1324–1326. Ibid., Table 5. Nos. 1327–1329. Ibid., Table 6. Nos. 1330–1345. Ueber den Einfluss warmer 4 per cent Soolbäder auf den Eiweissumsatz des Menschen. Inaug. Diss., Halle, 1892, pp. 16, 19. Nos. 1346–1354. Jahrb. Thier. Chem., 1892, p. 435. Nos. 1355–1357. Prager. med. Wochenschr., 18, p. 419. Nos. 1358–1364. Ztschr. physiol. Chem., 19, p. 278. Nos. 1365–1371. Therap. Monatsh., 8, p. 57. Nos. 1372–1374. The influence of artificial hot sand baths on the assimilation and metabolism of nitrogen and on the quantity of neutral sulphur in the urine of healthy man. Inaug. Diss. (Russian), St. Petersburg, 1896, p. 36. Nos. 1375–1377. Ibid., p. 38. Nos. 1378–1380. Ibid., p. 40. Nos. 1381–1383. Ibid., p. 42. Nos. 1384–1386. Ibid., p. 44. Nos. 1387–1389. Ibid., p. 46. Nos. 1390–1392. Ibid., p. 48. Nos. 1393–1395. Ibid., p. 50.

Nos. 1084–1095 were made by Frantzius in St. Petersburg in 1886. The object was to study the influence of fresh-water baths and the mineral baths of Staraia-Russa on the metabolism and assimilation of nitrogen. The subjects were 4 healthy boys. In general, each experiment consisted of three periods, (1) without baths, (2) with salt baths of 35° C., and (3) with fresh-water baths of the same temperature. The baths lasted half an hour. On Sundays they were omitted. The mineral spring of Staraia-Russa yields an alkaline salt water of medium concentration. An analysis in 1881 showed the following composition: In 1,000 grams there were 19.380 grams total solids, consisting of 13.332 grams sodium chlorid (NaCl), 1.901 grams calcium chlorid ($CaCl_2$), 1.769 grams magnesium chlorid ($MgCl_2$), 0.301 grams potassium chlorid (KCl), 0.070 grams calcium and magnesium bicarbonate, 0.31 grams ferric oxid (Fe_2O_3), 0.019 grams bromin compounds, and 1.961 grams gypsum ($MgSO_4$). The specific gravity of the water was 1.016 at 15° C., and the reaction neutral. One thousand grams of water also contained 1.12 grams hydrogen sulphid (H_2S), 0.08 grams oxygen, and 0.42 grams nitrogen.

The food consisted of a mixed diet. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author drew the following conclusions: Under the influence of warm mineral baths the metabolism and assimilation of nitrogen improved. Under the influence of fresh-water baths no marked effect on the metabolism of nitrogen was observed, but in most cases the assimilation of nitrogen improved. The increase in weight of the children was greater under the influence of mineral baths than of fresh-water baths of the same temperature. The increase of weight was not directly dependent upon the storing up of protein in the organism.

Nos. 1096–1107 were made by Feit in St. Petersburg in 1887. The object was to study the influence of cold, wet rubbing on the metabolism and assimilation of nitrogen. The subjects were 4 healthy students. Each experiment lasted 21 days, and was divided into three periods of 7 days each. In the first period the conditions were normal, in the second period variations in metabolism and assimilation of nitrogen under the influence of friction were observed, and in the third period the after effects of the special friction treatment were studied.

The rubbing was done with rough cloths according to Winternitz's directions. The subjects were wrapped in the rough cloths and rubbed for 2 or 3 minutes until the skin showed some redness. They were then wrapped up in blankets wrung out of cold water and rubbed. This treatment was applied in order to bring about an expansion of the blood vessels of the skin, which would attract more blood and produce more heat at the surface of the body. The temperature of the room and of the water in which the blanket was wet was recorded. The weights of the dry and wet blankets were also determined, so that the amount of water in the blankets could be calculated. Immediately after the rubbing the subject was placed in bed.

The food consisted of a simple mixed diet. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author gives the following conclusions: Under the influence of the special treatment the metabolism and assimilation of nitrogen increased in all cases. The appetite increased in three cases, but decreased in one case

Nos. 1108–1137. Three series of experiments were made by Evdokimov in St. Petersburg in 1887. The object was to study the influence of profuse perspiring on metabolism. The first series consisted of five experiments with healthy subjects. In this series the nitrogen of extractives was determined by taking the difference between the total nitrogen of the urine and the nitrogen of the urea (according to Lépine's directions). The second series consisted of three experiments with healthy subjects. The determination of the nitrogen of the urea was made after precipitating the extractives with phosphomolybdic acid (according to Thudichum) and Chavane and Richet's reagent. The third series consisted of two experiments with nephritic patients.

The subjects of the first series (Nos. 1108–1122) were soldiers. In order to obtain

more comparable results the diet of these subjects was the same as that of the nephritic subjects (1129–1137). It consisted of milk, bread, and tea. Each experiment lasted 7 days. On the fourth and fifth days profuse sweating was induced by inclosing the subject in a rubber bag which covered him up to the neck. A blanket was wrapped around the rubber bag. The sweating lasted for 1½ to 2 hours. The subject was then dried off and weighed. The perspiration was squeezed out from the bag into a glass cylinder and by repeating filtration (four times) freed from the suspended dirt, epidermis, etc. The quantity of perspiration varied in the healthy men in the first series from 215 to 655 cubic centimeters, in the second series from 62 to 142 cubic centimeters, and in the third series (nephritic subjects) from 116 to 288 cubic centimeters. The 7 days of observation were preceded by a preliminary period of 4 to 7 days during which the subjects became accustomed to the milk diet. On the first day of the preliminary test each subject took a bath. On the days of sweating the subjects took a bath of 40° C. and 20 minutes' duration in the morning before taking food. Immediately before the bath the subjects were weighed, and again after it, having first rubbed dry.

The nitrogen of the food, urine, feces, and perspiration was determined by the Kjeldahl-Borodin method.

More protein was digested during the sweating period, and less in the following period, not only as compared with the period of sweating but also with the preceding period. The quantity of nitrogen excreted decreased in most cases on the days of sweating or during the following period. The qualitative metabolism improved either in the period of sweating or in the following period, but frequently it was not paralleled with the quantitative improvement of the metabolism. The quantity of nitrogen found in the perspiration was so insignificant that it can be neglected in the study of the metabolism of nitrogen.

The results obtained in the second series are similar to those of the previous series with this difference that, owing to a more exact determination of the nitrogen of the urea, the changes in the different periods of observation were more marked than before.

In the third series the nitrogen of the albumen in the urine was also determined. This was done by determining the total nitrogen of the urine including albumen and the nitrogen of the urine after removing the albumen by Ludwig's method. The difference was taken as the nitrogen of the albumen.

The author sums up the result of the three series as follows: Under the influence of sweating more protein was digested and the metabolism of nitrogen increased qualitatively and quantitatively.

The metabolism of nitrogen in the nephritic subjects was lower in quality and quantity than in healthy persons. The urine contained more urea and less extractives. The amount of nitrogen in the perspiration was so insignificant in both nephritic patients and healthy persons that it need not be taken into consideration.

Nos. 1138–1143 were made by Sigrist at the therapeutic clinic in St. Petersburg in 1887 with healthy subjects. The object was to study the influence of thermally indifferent, fresh, and salt-alkali baths on the metabolism and assimilation of nitrogen. The plan was to divide each experiment into three periods—the first without baths, the second with fresh-water baths, and the third with salt-alkali baths. Only two experiments were successfully carried through from beginning to end. The temperature of the baths was 35° C., and each bath lasted 20 minutes. The salt-alkali baths were made by adding to the water common salt and potash in quantities corresponding to those contained in the "Essentuki No. 17" mineral spring. (See Nos. 744–755, Table 10.)

The author sums up his results as follows: Thermally indifferent fresh-water baths and also weak salt-alkali baths at first increased the metabolism of nitrogen. Later it again became about normal. The effect was slight in both cases. The influence of both kinds of baths on the assimilation of nitrogen was so insignificant that a definite conclusion could not be drawn.

Nos. 1144–1161 were made by Garine in St. Petersburg in 1887. The object was to study the influence of hot-air baths on the assimilation and metabolism of nitrogen in healthy subjects and subjects suffering from nephritis. Four experiments were made with healthy subjects and two with subjects suffering from chronic nephritis. The experiments usually lasted 15 days and were divided into three equal periods. In the second period hot-air baths were taken. The apparatus used for the bath consisted of a box 133 by 111 by 64 centimeters, in the cover of which was an opening for the head of the subject. The box contained a seat and was heated by means of a gas-burner. The bath was taken between 3 and 6 o'clock in the afternoon and lasted from 15 to 35 minutes. The temperature of the bath, as shown by a thermometer in the top, was 40 to 60° C., and by a thermometer in the side of the box 56 to 72.5°. After the bath the healthy subjects were wrapped up in woolen blankets for half an hour, and the diseased subjects for an hour or more.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: Hot-air baths, or, in other words, perspiration induced by a high temperature, improved the assimilation of nitrogen in all the subjects. In the case of healthy subjects the increase was noticeable in the third period also, though it was less than in the second period. The metabolism of nitrogen—that is, the ratio of nitrogen in the urine to assimilated nitrogen—was considerably increased in both the healthy and diseased subjects. The increase in the former case was noticeable in the third period, though it was less than in the second, and in the latter case it was considerably greater in the third period than in the second. The after effect of the baths was considerably greater in the case of the diseased subjects. Both the healthy and diseased subjects lost weight during the bath period, though the loss was usually made good in the third period.

Nos. 1162–1185 were made by Blagoveschchenski in St. Petersburg in 1888. The object was to study the influence of cold affusions on the metabolism and assimilation of nitrogen. The subjects were 8 healthy convicts confined in the St. Petersburg civil prison. The experiments were divided into three periods, the first and third under normal conditions, and the second with cold affusions. The affusions, which were made twice a day (at 7 in the morning and 6 in the evening), lasted a little over a minute. They were carried out as follows: The subject stood in a bath tub and 40 liters of water of the desired temperature was poured over the entire body, beginning at the head.

Since the regular prison food was insufficient for nutrition and difficult to analyze it was replaced by a diet consisting of bread, meat, butter, milk, etc. The subjects were allowed this food for 5 or 10 days before the test proper to accustom them to the new diet. During this time no analyses were made. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author sums up his results briefly as follows: Cold affusions increased the metabolism and assimilation of nitrogen, and decreased the quantity of the nitrogen retained in the body; they improved the appetite, induced restful sleep, and improved the general condition.

Nos. 1186–1200 were made by Makovetski in St. Petersburg in 1888. The object was to observe the influence of Russian steam baths on the metabolism and assimilation of nitrogen, and on the assimilation of fats in healthy subjects. The subjects were 4 medical students and a physician, and were all healthy, except the subject of Nos. 1189–1191. Each experiment was divided into three periods, the first and second of 5 days' and the third of 2 days' duration. In the second period steam baths were taken. The steam bath at the Military Clinical Hospital was used. The arrangement of the bath is described as follows: It consists of an anteroom, a soaping room, and a steaming room. A considerable portion of the latter is taken up by a stove and a "sweating loft." On entering the soaping room the subject has 3 or 4 bucketfuls of water poured over him and is then required to lie down for 10 minutes in the steaming room. He then returns to the soaping room, washes himself thoroughly,

and then goes to the third room, where an abundance of steam is generated by pouring water on the hot stove. After remaining 10 minutes in the "sweating loft" the bath is concluded by pouring 8 to 10 bucketfuls of water over the subject and rubbing dry.

The diet consisted of beef tea from which the fat was removed, white bread, plum jam, roasted meat from which the fat was removed, milk, tea, and blueberry jelly. The nitrogen in the food, urine, and feces (each defecation) was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: Under the influence of Russian steam baths the assimilation of nitrogen generally decreased on an average ½ per cent. The metabolism of nitrogen also decreased 1 to 15 per cent, or an average 8 per cent. In the first and second experiments (Nos. 1186-1191) the income of nitrogen in the second period remained the same as in the first, but was increased 5 per cent in the third period. In the third, fourth, and fifth experiments (Nos. 1192-1200) the income of nitrogen in the second period was 5 per cent less, and in the third period 19 per cent less than in the first period. In all the experiments the outgo of nitrogen in the urine in the second period as compared with the first period decreased from 6 to 13 per cent. The amount of nitrogen in the urine is directly dependent upon the intensity of metabolism and the amounts of nitrogen consumed and assimilated.

In the second period the ratio of nitrogen of urea to total nitrogen of urine increased on an average 2.4 per cent. Therefore the conclusion seems warranted that under the influence of steam baths the oxidation of protein is rendered more complete. The ratio of nitrogen of urea to total nitrogen of urine also increased in the third period on an average of 2.2 per cent.

The effects produced by steam baths on the subject of Nos. 1189-1191 differed in most respects from the others. This is explained by the fact that the subject was not in normal health.

Briefly, it may be said that under the influence of Russian steam baths the assimilation of protein and the metabolism of nitrogen decreased and the assimilation of fats increased. Although the latter point was discussed at length by the author it is not taken up in detail in the present discussion.

Nos. 1201–1218 were made in St. Petersburg in 1888 by Gopadze and Vatsadze. The object was to study the physiological effect of cold, thermally indifferent, hot, and Scotch douches on healthy man.

The subjects were 2 healthy soldiers. The experiments lasted 27 days and were divided into nine periods of 3 days each, a normal period alternating with a bath period. In the second period thermally indifferent douches (33° C.) were applied daily; in the fourth period cold douches (15° C.), in the sixth period hot douches (40° C.), and in the seventh period Scotch douches (varying from 45° to 15° and from 15° to 45° C.). The duration of the douche baths was 4 minutes in every case. In the application of the Scotch douche the bath began and ended with hot water, and in all nine changes of temperature from hot to cold and from cold to hot were made. The pressure of the water of the thermally indifferent and hot douches was 1 atmosphere, of the cold 1½, and of the Scotch 1 to 1½. Part of the water used in these experiments came from a spring with scarcely any mineral properties and part from a well. The douches were so arranged that all the body was subjected to the action of lateral streams and at the same time a shower fell upon the head and shoulders. The food consisted of a mixed diet. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author's summary of results bearing on metabolism and assimilation is as follows: The metabolism of nitrogen increased in both subjects under the influence of douches, the increase being greatest with the Scotch douche, followed by the cold, the hot, and the thermally indifferent douches in the order mentioned. In the period immediately following that with douches the increase in the metabolism of nitrogen was more or less constant. The assimilation of nitrogen improved under the influence of the douches from 1.1 to 3 per cent.

Nos. 1219–1257 were made by Aristov in St. Petersburg in 1889. The object was to study the assimilation of protein when enemas were given. The subjects were soldiers, either in active service or retired. Several of them were suffering from chronic constipation; the others were in normal health. Fourteen experiments were made, 11 of which were divided into three periods each; a period with enemas, preceded and followed by a period under normal conditions. In 3 experiments the last period was omitted.

The food consisted of a simple mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The enemas were given twice a day, at 8 a.m. and 6 p.m., and a liter of water was used each time.

The following conclusions were reached: During the enema period the assimilation of nitrogen by the subjects affected with constipation was less than during the first period, but became normal during the third period.

The assimilation of nitrogen by the subjects in normal health usually increased during the enema period as compared with the normal periods. During the third period it decreased in 4 cases and increased in 2 cases.

During the enema period the excretion of urea increased in all the subjects, and especially those affected with constipation.

Nos. 1258–1272 were made by Zavadski in St. Petersburg in 1890. The object was to study the influence of tepid baths on the metabolism and assimilation of nitrogen in healthy persons. The subjects were healthy young men. Five experiments were made, each being divided into three periods of four days. During the second period of all the experiments tepid baths were taken. In the first three experiments one-half-hour bath of 35° C. was taken daily, and in the others two baths were taken daily. Immediately on leaving the bath a sheet was thrown over the subject to dry him, but all rubbing was avoided.

The food consisted of bread, meat, bouillon, and tea. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author's conclusions were as follows: Under the influence of tepid baths the assimilation of the nitrogenous substances of the food by healthy men increases, the weight of the body increases, and the metabolism of nitrogen increases qualitatively as well as quantitatively. The influence of tepid baths on the losses through the skin and lungs and on the excretion of urine is not proportional, i. e., when the losses by the skin and lungs increase the quantity of urine excreted diminishes, and vice versa.

Nos. 1273–1287 were made by Nechayev in St. Petersburg in 1890. The object was to study the influence of salt baths on the metabolism and assimilation of nitrogen in healthy subjects. Five experiments are described, each of 12 days' duration, divided into three equal periods. Salt baths were taken during the second period. The baths were prepared by adding sufficient salt to 198 liters of water at 35° C. to make a 1 per cent solution. The subjects remained in the bath about half an hour and dried themselves lightly without rinsing off the salt water. The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: The salt baths increased the assimilation of nitrogen in the second period, and in the third period the increase became still more pronounced. The qualitative and quantitative metabolism of nitrogen was increased, and in most cases the quantitative increase was greater in the third than in the second period. In the majority of cases the subjects decreased in weight.

Nos. 1288–1311 were made by Voskresenski at St. Petersburg in 1891. The object was to study the influence of aromatic baths on the metabolism and assimilation of nitrogen in healthy persons. Eight experiments with healthy men are described. Each experiment was divided into three periods of 4 days each. During the second period aromatic baths were taken. The bath was prepared by pouring warm water (35° C.) over 358 grams of equal parts of camomile flowers, lavender flowers, mint leaves, rosemary leaves, snake root, and calamus root.

These aromatic substances were placed in a bag, which remained in the water during the bath, being frequently squeezed. In Nos. 1300–1311 the surface of the water was covered with linseed oil to prevent the inhalation of the aromatic vapor. This was done in order to compare the effect of the aromatic substances when absorbed through the skin and when the vapor was also inhaled.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: When the surface of the water was not covered with oil the aromatic bath increased the assimilation of nitrogen during the bath period, and in most cases for some time afterwards. During the bath period the metabolism of nitrogen was lowered, but became practically normal in the period after the bath. The qualitative metabolism of nitrogen was improved; that is, the ratio of the nitrogen of the incompletely oxidized substances of the urine to that of nitrogen of urea diminished.

When the surface of the water was covered with oil, aromatic baths diminished the assimilation of nitrogen, the metabolism of nitrogen was increased, and the increase was observed in the period after the bath. The qualitative metabolism of nitrogen was improved.

Nos. 1312–1329 were made by Velitchkine in St. Petersburg in 1891. The object was to study the influence of hot-air baths on the metabolism and assimilation of nitrogen and on the losses through the skin and lungs of healthy subjects. Six experiments are described. They were each of 15 days' duration, divided into three equal periods. In the second period hot-air baths were taken. The apparatus for the hot-air bath consisted of a wooden box 132 centimeters high, 70.4 centimeters wide, and 101.2 centimeters long. Its capacity was about 1 cubic meter. There was an opening in the cover for the head of the subject. The walls of the box were thick and lined with sheet iron. Inside the box there was a seat. The bath was heated by means of alcohol lamps. When the subject first entered the bath the temperature was increased to 40° C. and kept at that temperature for about 20 to 25 minutes and then increased. As long as the temperature remained under 60° C. the subjects experienced agreeable sensations and the pulse gradually became more rapid. At 60° the beating of the heart became more violent, the temples began to throb, perspiration was very profuse, and breathing became labored. At 70° respiration became frequent and the subjects experienced a sensation of shortness of breath and lack of air. They were thirsty and their mouths were dry. Small pieces of ice were taken for quenching the thirst. The face became red, the head perspired freely, and a ringing in the ears was noticed. Finally, when the temperature reached 80°, some of the subjects experienced slight nausea and vertigo.

The food consisted of a simple mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author draws the following conclusions: The assimilation of nitrogen was greater in the bath period than in the first period. During the third period the assimilation of nitrogen was also greater than in the first period, although less than during the second. The metabolism of nitrogen increased in the bath period in all cases and decreased in the third period in 4 cases. The amount of urea excreted increased during the bath period, and the increase was still observed in the third period. During the bath period the quantity of feces diminished in 5 cases.

Nos. 1330–1345. An experiment was made by Köstlin at the medical institute of the University at Halle in 1892 to study the influence of warm salt baths on the metabolism of protein. This is included in Nos. 1330–1338. The observer himself was the subject. The food consisted of a mixed diet. A considerable quantity of meat was purchased at a time and the connective tissue, etc., removed as far as possible. It is not stated that the composition of the food was determined. The inference is that it was calculated. The nitrogen in the urine was determined by the Kjeldahl method. The nitrogen in the feces was added by the compilers from the average of Makovetski's experiments (Nos. 1186–1200), in which the food consisted of a mixed diet and contained about the same amount of nitrogen.

The experiment lasted 23 days. On several days warm salt baths (34–35° C.) were taken. The subject remained in the bath an hour or an hour and a quarter. The bath was prepared by adding sufficient "Stassfurt bath salt" to make a 4 per cent solution.

Control experiments (Nos. 1339–1345) are reported by the author which were made by Klingmuller and Peiser in which they themselves were the subjects. In Peiser's experiment the amount of nitrogen in the food is not stated and the results are not included in the table. The inference is that it was the same as in the other tests. On two days before the salt bath was taken 14.4 grams of nitrogen was excreted in the urine, and on the day the bath was taken only 13.1 grams.

From all these experiments the conclusion was reached that warm salt baths diminished the excretion of nitrogen in the urine.

Nos. 1346–1354 were made by Formanek at the University of Prague in 1892 (?) to determine whether warm baths had any influence on the metabolism of nitrogen. The experiments were of 12 to 14 days' duration, and each was divided into three periods. In the second period warm baths were taken. The baths were of several kinds; for instance, in No. 1347 the subject took an air bath (81° C.) of 20 minutes' duration, followed by a steam bath (51° C.) of 15 minutes' duration and a shower bath with lukewarm water. The subjects were the investigator and 2 other young medical students. The food was a comparatively simple mixed diet which included meat, Emmenthaler cheese, bread, etc. The nitrogen in food, urine, and feces was determined.

The conclusion was reached that the continued use of warm baths increased the amount of metabolized nitrogen. This effect was not noticed unless the baths were taken more than 1 day.

Nos. 1355–1357 and Nos. 1702–1714, Table 17, were made by Troïtsky in 1892 at the military hospital located at the "moor baths" of Ssaki in the Crimea. The object was to study the influence of the moor baths upon metabolism. Ssaki is a small Tartar village a short distance from the towns of Eupatoría and Simferopol. A portion of the Black Sea was cut off from the rest by the formation of a sand bar. The salt water in the small lake thus formed became more concentrated, and dissolved organic and inorganic substances from the soil. These in some cases united with the salts present in the water and formed new chemical compounds. The result is a "brine" (*Seerapp*), which is of very different composition from the sea water. A moor has gradually formed in this salt lake. The soil of the moor when wet is black and sticky, having the appearance of shoemakers' wax. When dry, however, it looks like the other soil of the region. The following analyses of the moor water and soil were made by Professor Fleck, of Dresden, in 1876:

Composition of Ssaki moor water.

(Specific gravity at 18° C.=1.191.)

[In 1,000 grams water.]

	Grams.
Sodium	61.586
Magnesium	14.881
Chlorin	130.725
Bromin	0.146
Sulphuric acid	10.920
Hydrogen sulphid	0.004
Organic matter	0.697
Sulphur, potassium, and lithium	Traces.

In 1,000 grams of water there were 221.47 grams of dry matter made up of sodium chlorid 156.64 grams, magnesium chlorid 47.96 grams, magnesium bromid 0.17 gram, magnesium sulphid 14.02 grams, and calcium sulphid 2.68 grams.

The composition of the total soil and the soluble and insoluble portions were as follows:

Composition of Ssaki moor soil.

	Per cent.
Total soil:	
Water	26.64
Silica	31.30
Aluminum oxid	13.14
Calcium	8.81
Magnesium	0.64
Sodium	1.98
Iron	1.13
Chlorin	3.06
Carbon dioxid	3.90
Sulphuric acid	5.10
Sulphur	1.23
Soluble portion:	
Calcium sulphid	6.50
Magnesium sulphid	1.92
Sodium chlorid	5.05
Water	24.64
Hydrogen sulphid	0.001
Insoluble portion:	
Aluminum silicate	24.64
Calcium silicate	3.04
Silica	17.92
Calcium carbonate	8.81
Iron sulphid	0.14
Ferric oxid	1.49
Sulphur	1.18
Organic matter	2.67

Both the soil and the water are used for the so-called baths. Platforms are built on the moor, and on these the soil is heaped up after it has been carefully freed from stones, shells, etc. The soil is saturated with the salt water and formed into a smooth oval "bed" 3 or 4 inches thick. This is done early in the morning. When the weather is favorable the sun will warm the upper part of the soil to about 51° C. The lower layers of soil are 5° or 6° cooler. When the upper surface has a temperature of 47–50° C. the "bath" is ready for use. If, however, the lower layers of soil are only about 3° cooler than the upper layers the "bath" can not be used. The patient lies down with his arms extended on this bed of moor soil and is covered up to the neck with the warm earth, the head being protected from the sun. The patient perspires freely, and remains covered with the earth for 15 to 25 minutes. The earth is then removed, the patient taken to the bath house and bathed in the moor water or brine which has been warmed to about 38°, and then with fresh water of the same temperature. The patient is then thoroughly rubbed down, and remains in his room 1 to 3 hours, perspiring freely. Tea and water are taken to quench the thirst. Immediately after the bath the temperature of the body often rises to about 50°. In an hour or two it becomes normal, the patient feels very well, and has a good appetite. The usual custom is to take a bath for two days, then omit it for one day. If they are taken too often the patients frequently suffer from sleeplessness, headache, and loss of appetite. The course of baths lasts about 6 weeks, the patient receiving 10 to 20 baths. The above are called "natural" or "earth" baths.

In bad weather, or under some other conditions, another sort of bath is given which is not "full strength." A large tub is filled with moor soil and hot moor brine. This is mixed until it has the consistency of thin porridge. When it has cooled to

about 41–42° the patient is immersed to the neck in the bath and remains 10 to 20 minutes. The patient is then bathed in brine, etc., as in the "natural" baths. Sometimes baths are taken in the salt water alone.

The baths of Ssaki are recommended for rheumatism of all kinds, tertiary syphilis, diseases of the bones and periosteum, lameness, and diseases of the uterus.

The subjects of Troïtsky's experiments were soldiers and inmates of the Military Hospital. They were all suffering from various diseases, except the subject of Nos. 1355–1357, who was in normal health. His diet consisted of bread, rice, oil, and tea or water. He remained in his room during the experiment and slept a considerable portion of the time. The nitrogen excretion was greater than the amount consumed, but was diminished by the baths. The food of the other subjects consisted of bread, meat, milk, butter, etc. The nitrogen in the food, urine, and feces was determined, and the amount in the perspiration in several cases was calculated.

The diseased subjects were benefited by the baths. In no case was nitrogen equilibrium reached. The excreted nitrogen was always less than the amount consumed. The conclusion was reached that the baths diminished the excretion of nitrogen. This would indicate that the metabolism of nitrogen was lowered. After the baths it increased. At the same time that the nitrogen metabolism decreased the assimilation of nitrogen of the food increased.

Nos. 1358–1364 were made by Formanek at the University of Prague in 1893 to investigate the influence of cold baths on the excretion of nitrogen and uric acid. The subject was a medical student. The food consisted of sausage, cheese, bread, rice, etc., and a little tea which was left out of account in determining the amount of nitrogen consumed. Water and beer were also used as beverages. The nitrogen in food, urine, and feces was determined by the Ludwig method (with Horbaczewski's modification). The uric acid in the urine was determined by the Salkowski-Ludwig method. A preliminary period of 7 days (no analyses made) was followed by a normal period without baths. Then on 1 day a cold bath (15° C.) lasting ½ hour was taken. A second normal period was followed by a bath period. Two baths of about ½ hour's duration and about 15° C. temperature were taken daily. A third normal period was followed by a bath period. On one day 1 and on the other 2 baths of about the same duration and temperature as in the other cases were taken. The experiment closed with a normal period. The temperature of the subject was taken three times daily and a number of times at short intervals after each bath. The normal temperature was about 37° C. It was lower than this immediately after a bath, but became normal after a few hours. The subject did not become tired of the diet and gained a little in weight during the experiment. One cold bath did not change the excretion of nitrogen materially. When several baths were taken the excretion of nitrogen in the urine was noticeably increased. The feces also contained more nitrogen, showing that the protein was not as well digested as during a normal period. The baths increased the excretion of uric acid a little and the effect was noticeable for several days.

Nos. 1365–1371 were made by Topp at Halle in 1893 to study the influence of hot baths. The observer himself was the subject. The author's age and weight are not recorded. He states, however, that during the experiments his weight remained practically unchanged. The food consisted of a simple mixed diet, which was followed for 15 days before the experiment proper began. It is not stated that the food was analyzed. The nitrogen in the urine was determined by the Kjeldahl method. The subject was in nitrogen equilibrium at the beginning of the experiment, and practically the same amounts of nitrogen were excreted on each of the days on which no baths were taken. The nitrogen in the feces was not determined. In adding the experiments to the present compilation the figures were supplied by the compilers. The value, which is unusually low, was selected because, as previously stated, the subject remained in nitrogen equilibrium while his weight remained unchanged. On several days hot baths of from 15 to 45 minutes' duration were taken. An interval of several days elapsed between Nos. 1368 and 1370. On the days on

which hot baths were taken somewhat more nitrogen was excreted in the urine. This effect was noticed, though less markedly, on the succeeding day.

The author concludes that the artificial raising of the body temperature causes an increased breaking down of protein. The experiments of several other investigators are quoted in detail, and the general subject of hot baths is discussed at length.

Nos. 1372–1395 were made by Bezrodnov at St. Petersburg in 1896. The object was to investigate the influence of artificial sand baths on the metabolism and assimilation of nitrogen and on the quantity of neutral sulphur excreted in the urine by healthy subjects. Eight experiments of 12 days' duration were made. They were divided in three periods of 4 days each. The sand baths were taken during the second period. They were prepared by covering a mattress with a layer of hot sand (60°–70° C.) several inches deep. The sand was covered with blankets and a sheet. The subjects were placed on the bed and covered with blankets, except the head, and bags of hot sand were placed at the feet. The treatment lasted from 30 to 40 minutes. The subjects were then placed on an ordinary bed and kept covered until they ceased to perspire.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: Artificial sand baths diminished the assimilation of protein during the period in which the baths were taken. In the succeeding period the assimilation became normal. The qualitative metabolism of nitrogen improved and the improvement was noticeable in the period following the sand baths. The relative quantity of neutral sulphur in the urine was diminished; that is, the process of oxidation improved. Generally speaking, the subjects felt better when sand baths were taken.

EXPERIMENTS TO DETERMINE THE INFLUENCE OF PREGNANCY AND CHILDBIRTH.

In Table 13 are included 40 tests with women in which the influence of pregnancy and childbirth on the metabolism and excretion of nitrogen was determined.

An examination of the literature shows that very few such experiments have been carried on. During pregnancy and lactation unusual demands are made on the parent organism to provide for the growth and nourishment of the fœtus. It is an important question to determine whether the parent organism requires less material for its own needs, devoting the remainder of its normal supply to the young organism, or whether an increased income is required; that is, in brief, whether the fœtus is provided with nourishment at the expense of the parent organism or whether the extra material must be supplied from outside. A considerable number of experiments during the period of lactation have been made with cows and goats: that is, this work has usually been carried on in connection with feeding experiments or in the study of the economic production of milk (Table 27, Nos. 2307–2325, and Table 32, Nos. 3036–3068). A few experiments with dogs on the influence of various phases of sexual life on metabolism are included in Table 28 (Nos. 2572–2581), and in Table 29 (Nos. 2970–2972); and with rabbits in Table 34 (Nos. 3272–3287).

TABLE 13.—*Experiments to determine the influence of pregnancy and childbirth.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1396	1894	Zachajewsky	Woman I	19	58.0	641 gm. bread and meat, 478 cc. milk, 1,292 cc. tea and water.	8	18.7	14.1	1.2	+ 3.4	Last days of pregnancy.
1397	1894	.....do	Woman II	25	67.9	604 gm. bread and meat, 408 cc. milk, 1,354 cc. tea and water.	13	17.8	16.0	0.8	+ 1.0	Do.
1398	1894	.....do	Woman III	22	54.7	383 gm. bread and meat, 605 cc. milk, 1,468 cc. tea and water.	6	11.6	9.9	0.7	+ 1.0	Do.
1399	1894	.....do	Woman IV	30	58.7	668.9 gm. bread and meat (meat 3 days only), 726.4 cc. milk, 1,402 cc. tea and water.	9	18.6	14.0	0.8	+ 3.8	Do.
1400	1894	.....do	Woman V	27	76.1	783 gm. bread and meat, 553 cc. milk, 1,895 cc. tea and water.	18	20.5	24.5	0.6	— 4.6	Do.
1401	1894	.....do	Woman VI	22	57.4	820.5 gm. bread and meat, 610 cc. milk (3 days) 1,702 cc. tea.	6	24.1	18.5	1.8	+ 3.8	Do.
1402	1894	.....do	Woman VII	22	60.3	913 gm. bread and meat, 610 cc. milk, 485 cc. tea and water.	2	28.7	22.0	0.6	+ 6.1	Do.
1403	1894	.....do	Woman VIII	29	63.3	1,000 gm. bread and meat, 650 cc. milk, 3,333 cc. tea and water.	1	32.5	21.7	2.0	+ 8.8	Do.
1404	1894	.....do	Woman IX	20	55.1	1,030 gm. bread and meat, 650 cc. milk, 1,170 cc. tea and water.	1	32.1	18.5	2.6	+11.0	Do.
1405	1894	.....do	Woman I	19	......	450–600 gm. bread and meat, 402–685 cc. milk, 620–1,485 cc. tea and water.	1	17.9	13.8	0.3	+ 3.8	Childbirth. Nitrogen "in urine" = nitrogen of urine, milk, and lochial secretions in Nos. 1405–1435.
1406	1894	.....do	.....do	19	......	Bread, meat, milk, tea, and water	4	15.0	16.0	1.2	— 2.2	First to fourth day after childbirth.
1407	1894	.....do	.....do	19	......	.....do	2	15.3	13.7	0.9	+ 0.7	Fifth and sixth days after childbirth.
1408	1894	.....do	Woman II	25	......	509 gm. bread and meat, 287 cc. milk, 1,477 cc. tea and water.	6	15.1	19.4	0.6	— 4.9	First to sixth day after childbirth.
1409	1894	.....do	.....do	25	......	Bread, meat, milk, tea, and water	2	17.1	18.8	0.0	— 1.7	Seventh and eighth days after childbirth.
1410	1894	.....do	.....do	25	......	Very little food	1	18.5	16.4	1.8	+ 0.3	Ninth day after childbirth.
1411	1894	.....do	Woman III	22	......	354–455 gm. bread and meat, 110–370 cc. milk, 915–1,660 cc. tea and water.	1	0.0	13.7	0.0	—13.7	First day after childbirth.
1412	1894	.....do	.....do	22	......	Bread, meat, milk, tea, and water	3	7.6	16.3	0.4	— 9.1	First to third day after childbirth.

TABLE 13.—*Experiments to determine the influence of pregnancy and childbirth*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1413	1894	Zachajewsky	Woman III	22		Bread, meat, milk, tea, and water	6	12.9	14.5	0.6	— 2.2	Fourth to ninth day after childbirth.
1414	1894	do	do	22		do	1	11.7	9.4	2.6	— 0.3	Tenth day after childbirth.
1415	1894	do	Woman IV	30		516–760 gm. bread and meat, 190–670 cc. milk, 1,345–2,370 cc. tea and water.	3	15.4	15.2	0.7	— 0.5	First to third day after childbirth.
1416	1894	do	do	30		Bread, meat, milk, tea, and water	1	14.8	19.6	0.2	— 5.0	Fourth day after childbirth.
1417	1894	do	do	30		do	7	21.1	19.3	0.8	+ 1.0	Fifth to eleventh day after childbirth.
1418	1894	do	Woman V	27		800.4 gm. bread and meat, 659 cc. milk, 1,324 cc. tea and water.	1	30.0	15.8	3.5	+10.7	Childbirth.
1419	1894	do	do	27		Bread, meat, milk, tea, and water	3	15.6	22.0	1.1	— 7.5	First to third day after childbirth.
1420	1894	do	do	27		do	3	28.7	24.2	2.5	+ 2.0	Fourth to sixth day after childbirth.
1421	1894	do	Woman VI	22		1,000 gm. bread and meat, 500 cc. milk, 2,000–3,000 cc. tea and water.	3	27.2	27.5	1.4	— 1.7	First to third day after childbirth.
1422	1894	do	do	22		Bread, meat, milk, tea, and water	1	34.4	36.4	1.7	— 3.7	Fourth day after childbirth.
1423	1894	do	do	22		do	7	38.4	34.1	2.5	+ 1.8	Fifth to eleventh day after childbirth.
1424	1894	do	Woman VII	22		do	1	7.5	20.7	0.2	—13.4	Childbirth.
1425	1894	do	do	22		do	3	23.2	26.7	0.6	— 4.1	First to third day after childbirth.
1426	1894	do	do	22		do	4	29.4	28.0	1.0	+ 0.4	Fourth to seventh day after childbirth.
1427	1894	do	do	22		do	1	34.5	34.3	1.1	— 0.9	Eighth day after childbirth.
1428	1894	do	Woman VIII	29		874 gm. bread and meat, 482 cc. milk, 1,183 cc. tea and water.	3	25.6	27.8	1.1	— 3.3	First to fifth day after childbirth.
1429	1894	do	do	29		Bread, meat, milk, tea, and water	2	28.5	28.1	2.7	— 2.3	Fourth and fifth days after childbirth.
1430	1894	do	do	29		do	1	33.1	28.8	3.7	+ 0.6	Sixth day after childbirth.
1431	1894	do	Woman IX	20		do	2	6.9	17.8	1.1	—12.0	Childbirth.

1432	1894	....do	....do	20	......	....do	1	5.3	18.3	0.4	—13.4	First day after childbirth.
1433	1894	....do	....do	20	......	....do	4	15.7	17.2	0.3	— 1.8	Second to fifth day after childbirth.
1434	1894	....do	....do	20	......	....do	2	18.9	16.4	2.4	+ 0.1	Sixth and seventh days after childbirth.
1435	1894	....do	....do	20	......	....do	2	22.2	19.5	1.4	+ 1.3	Eighth and ninth days after childbirth.

Nos. 1396-1404. Ztschr. Biol., 30, pp. 383-398. Nos. 1405-1407. Ibid., p. 408. Nos. 1408-1410. Ibid., p. 411. Nos. 1411-1413. Ibid., p. 413. Nos. 1415-1417. Ibid., p. 415. Nos. 1418-1423. Ibid., p. 418. Nos. 1424-1427. Ibid., p. 422. Nos. 1428-1430. Ibid., p. 425. Nos. 1431-1435. Ibid., p. 428.

Nos. 1396–1435 were made by Zachajewsky at Kasan, Russia, in 1890–91. The object was to investigate the metabolism of nitrogen during childbirth and on the days preceding and immediately following it. The subjects were 9 patients in Professor Fermanoff's hospital for obstetrics. The analytical work was done in Professor Techerbakoff's laboratory. The diet was simple, consisting of meat, bread, milk, tea, and sometimes a little butter. Each article was weighed or measured. Generally the food was especially prepared for these experiments. The meat was cooked in butter or stewed. The bread was the so-called French bread (probably white bread). The milk was boiled. The food, urine, and feces were analyzed. Nos. 1396–1404 are the experiments made during pregnancy and Nos. 1405–1435 those during and after confinement. In Nos. 1405–1427 the milk secreted and the lochial discharges were also analyzed. With the subjects of Nos. 1396–1398 this was the first confinement. In all except two cases there was a gain of nitrogen.

In the author's opinion the subjects pregnant for the first time did not assimilate the nitrogen of the food as well as those who had been pregnant more than once. The latter also retain more nitrogen in the organism.

The effect of the frequency of pregnancy on the amount and composition of the urine is also discussed. During confinement there was in every case a considerable loss of nitrogen. This was gradually made good, and after a longer or a shorter time the nitrogen metabolism again became normal—that is, the subjects were in nitrogen equilibrium. Varying quantities of food were consumed by the different subjects, and in the author's opinion it is not possible to specify the proper amount of nitrogen for the dietary of patients during confinement. The dietary should be abundant and consist of foods easily assimilated. The amount of nitrogen excreted in the milk (8 to 9 per cent of the total nitrogen assimilated) was not large compared with that excreted in the urine. The amount of reducing substances in the urine was determined. This was found to be considerable, and in the author's opinion consisted of milk sugar. Many other questions are discussed in detail from a medical standpoint.

The amount of nitrogen excreted in the perspiration has been a matter of considerable discussion. It is usually considered to be so small that it is left out of account in most experiments on metabolism.

Zachajewsky quotes the following experiment made by Jefdokinoff. The subjects were men who were inclosed in rubber bags. This may have increased the amount of perspiration. Analysis showed that nitrogen formed 0.044 per cent of the total.

Oddi and Vicarelli[1] have published results of experiments with rats in which the influence of gestation on the respiratory quotient was studied. The conclusion was reached that gestation is characterized by an increased combustion of carbohydrates in the body while the nitrogenous material is used for the nutrition and development of the fœtus.

EXPERIMENTS TO DETERMINE THE INFLUENCE OF MENSTRUATION.

In Table 14 are included 11 tests with women in which the metabolism and excretion of nitrogen during menstruation was investigated. The number of experiments in this and in the preceding section is limited. The questions investigated in the two sections are closely connected and might be included under the general head of influence of sexual life on metabolism. Tests with dogs similar to those in this table are found in Table 29 (Nos. 2964–2969).

[1]Arch. Ital. Biol., 15 (1891), p. 367.

TABLE 14.—*Experiments on the influence of menstruation.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1436	1893.	Schrader	Woman	17	......	Meat, butter, white bread, etc. (106.8 gm. fat, 189.9 gm. carbohydrates, 1,955 gm. water, 2,062 calories).	6	10.6	10.0	1.3	—0.7	Before menstruation.
1437	1893.	....do	....do	17	......	107 gm. fat, 692.3 gm. carbohydrates, 1,956.7 gm. water, 2,058 calories.	3	10.7	9.1	0.7	+0.9	Menstruation.
1438	1893.	....do	Woman	19	......	250 gm. rice, 60 gm. butter, 25 gm. cocoa, 15 gm. salt, 50 gm. sugar, 80 gm. white bread, 175 gm. meat, 500 gm. soup, 150 cc. wine, 560 cc. seltzer, 500 cc. water (72.2 gm. fat, 328.1 gm. carbohydrates, 12 gm. alcohol, 1.863.4 gm. water, 2,252 calories).	6	11.0	8.5	1.8	+0.7	Before menstruation.
1439	1893.	....do	....do	19	......	....do	6	11.0	7.6	1.2	+2.2	Menstruation.
1440	1893.	....do	Woman	20	......	93.7 gm. fat, 245.3 gm. carbohydrates, 7.5 gm. alcohol, 2,320 gm. water, 2,204 calories.	4	12.8	11.7	1.2	—0.1	Before menstruation.
1441	1893.	....do	....do	20	......	94.4 gm. fat, 253.5 gm. carbohydrates, 7.5 gm. alcohol, 2,326 gm. water, 2,252 calories.	5	13.1	10.8	1.0	+1.3	Menstruation.
1442	1893.	....do	Woman	35	......	Mixed diet, furnishing 2,500 calories	7	16.4	14.3	1.6	+0.5	Before menstruation.
1443	1893.	....do	....do	35	......	....do	2	15.9	15.0	1.0	—0.1	Menstruation.
1444	1893.	....do	Woman	21	......	Mixed diet, containing 109.3 gm. fat and furnishing 2,201 calories.	2	15.3	13.4	1.5	+0.4	Before menstruation.
1445	1893.	....do	....do	21	......	Mixed diet, containing 109 gm. fat and furnishing 2,198 calories.	4	15.4	13.0	1.5	+0.9	Menstruation.
1446	1893.	....do	....do	21	......	Mixed diet, containing 108.8 gm. fat and furnishing 2,179 calories.	1	15.4	13.7	1.5	+0.2	After menstruation.

Nos. 1436, 1437. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, Pt. II, p. 136. Nos. 1438, 1439. Ibid., p. 138. Nos. 1440, 1441. Ibid., p. 140. Nos. 1442–1446. Ibid., p. 141.

Nos. 1436–1446 were made by Schrader at the Charité Hospital in Berlin in 1891–92 to study the effect of menstruation on the metabolism of nitrogen. The subjects were women who were convalescing from rheumatism. The sexual organs were normal in every case. The food was a simple mixed diet consisting of meat, bread, soup, rice, etc. The food was analyzed and the nitrogen, phosphoric acid, and sodium chlorid in the urine, and the nitrogen, and in some cases the fat in the feces, were determined.

On the day after (No. 1437) the food contained 11.4 grams of nitrogen and the urine 9.8 grams. The feces were not analyzed. Assuming that they contained 0.7 gram of nitrogen (the same value as on the preceding day) there was a gain of 0.9 gram of nitrogen. In every case except one the excretion of nitrogen in the urine and feces was diminished during menstruation.

The subject is discussed at considerable length.

An experiment on the influence of menstruation on metabolism was reported by Rabuteau,[1] although the balance of income and outgo was not determined. The subject was a young woman. The experiment covered 19 days, including 3 days before and 11 after the menstrual period. The author states that the daily diet was uniform during the whole test, although the amount and composition of the food are not recorded. The quantity of urine excreted daily, the urea content, and the body temperature were recorded. It is not stated that the feces were collected or analyzed. On an average somewhat less urine was excreted during the menstrual period than at other times. The average amount of nitrogen (calculated from the urea) excreted in the urine per day during the menstrual period was 7.8 grams; before and after this period, 9.2 and 8.5 grams, respectively. In the author's opinion the excretion of urea is diminished by menstruation. This is in accord with results which he[2] obtained in an earlier experiment. The author believes that during the menstrual period the excretion of carbon dioxid was also diminished. This was contrary to the opinion of Andral and Gavarret,[3] who determined the amount of carbon dioxid excreted by men and women at various periods from youth to old age.[4]

EXPERIMENTS ON THE INFLUENCE OF COPIOUS AND DIMINISHED WATER DRINKING.

In Table 15 are included 12 experiments with men in which copious amounts of water were drunk, and 27 experiments with men in which small amounts of water were consumed. The object of the experiments was to investigate the influence of copious and diminished water drinking on metabolism and the excretion of nitrogen. The consumption of limited amounts of water is recommended by Oertel for the relief of corpulency.

Similar experiments are included in Table 17 (Nos. 1618–1633).

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[1] Gaz. hebd. Med. et Chirurg., 7 (1870), p. 402.

[2] Compt. Rend. Soc. Biol., 5. ser., 2 (1870), p. 75.

[3] Ann. Chim. et Phys., 3. ser., 7 (1843), p. 129.

[4] Sondén and Tigerstedt have recently reported a large number of experiments (1) on the total excretion of carbon dioxid by men and women of different ages; (2) on the excretion of carbon dioxid and nitrogen by man at different hours in the day; (3) on the influence of muscular work on carbon dioxid excretion, and (4) on the total metabolism of individuals of different ages. The influence of various phases of sexual life was not, however, the subject of a special study. (Skand. Arch. Physiol., 6 (1895), p 1; Experiment Station Record, 8, p. 242.)

TABLE 15.—*Experiments on the influence of copious and diminished water drinking.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1447	1886	Ter-Grigorianz	Student (Z.)		65.3	—— gm. bread, 600 cc. milk, 450 cc. bouillon, 200 gm. meat, 200 gm. potato.	7	23.2	21.0	1.8	+0.4	
1448	1886	do	do		67.5	Food same as No. 1447, with 1,200 cc. water	7	22.7	20.6	1.5	+0.6	
1449	1886	do	do		68.1	Food same as No. 1447, with 2 400 cc. water	7	22.5	21.7	2.0	—1.2	
1450	1886	do	Student (S.)		55.9	Same as No. 1447	7	23.1	18.7	2.5	+1.9	
1451	1886	do	do		56.1	Food same as No. 1447, with 1,200 cc. water	7	22.7	20.0	1.8	+0.9	
1452	1886	do	do		56.1	Food same as No. 1447, with 2,400 cc. water	7	23.1	20.5	2.6	0.0	
1453	1886	do	Woman (G.)		45.5	211 gm. bread, 300 cc. bouillon, 100 gm. meat, 200 gm. potato.	7	9.4	7.9	0.9	+0.6	
1454	1886	do	do		45.4	Food same as No. 1453, with 1,200 cc. water	7	9.3	8.1	0.8	+0.4	
1455	1886	do	do		45.3	Food same as No. 1453, with 2.200 cc. water	7	9.5	9.0	0.7	—0.2	
1456	1886	do	Observer		55.4	595 gm. bread, 450 cc. bouillon, 100 gm. meat, 100 gm. potato.	7	15.7	11.9	2.3	+1.5	
1457	1886	do	do		56.7	Food same as No. 1456, with 1,200 cc. water	7	17.0	14.7	2.1	+0.2	
1458	1886	do	do		57.1	Food same as No. 1456, with 2,400 cc. water	7	16.9	15.8	2.4	—1.3	
1459	1889	Karchagin	Student (B.)		66.2	Boiled meat, beef tea, butter, milk, white bread, 2,231 cc. water and tea.	5	20.2	21.0	1.5	—2.3	
1460	1889	do	do		61.0	Food same as No. 1459, with 1,106 cc. water and tea.	5	20.0	20.6	0.9	—1.5	
1461	1889	do	do		60.8	Food same as No. 1459, with 2,323 cc. water and tea.	5	20.1	21.6	1.5	—2.0	
1462	1889	do	Student (N.)		58.0	Food same as No. 1459, with 3,902 cc. water and tea.	5	24.4	22.7	1.8	—0.1	
1463	1889	do	do		57.9	Food same as No. 1459, with 1,553 cc. water and tea.	5	18.5	17.0	1.4	+0.1	
1464	1889	do	do		58.3	Food same as No. 1459, with 3,904 cc. water and tea.	5	24.0	22.8	1.3	—0.1	
1465	1889	do	Student (G.)		63.1	Food same as No. 1459, with 3,193 cc. water and tea.	5	30.1	28.0	1.5	+0.6	
1466	1889	do	do		62.0	Food same as No. 1459, with 1,386 cc. water and tea.	5	28.2	26.2	0.9	+1.1	
1467	1889	do	do		63.0	Food same as No. 1459. with 3,189 cc. water and tea.	5	32.5	31.2	1.5	—0.2	
1468	1889	do	Student (S.)		63.0	Food same as No. 1459, with 2,545 cc. water and tea.	5	27.0	23.5	1.8	+1.7	
1469	1889	do	do		61.0	Food same as No. 1459, with 1,192 cc. water and tea.	5	29.1	24.1	0.8	+6.2	

TABLE 15.—*Experiments on the influence of copious and diminished water drinking*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1470	1889	Karchagin	Student (S.)		61.8	Food same as No. 1459, with 2,530 cc. water and tea.	5	29.0	25.7	2.7	+0.6	
1471	1889	....do	Student (D.)		62.3	Food same as No. 1459, with 2,918 cc. water and tea.	5	28.3	26.4	1.4	—0.5	
1472	1889	....do	....do		60.3	Food same as No. 1459, with 1,246 cc. water and tea.	5	25.0	23.3	1.1	+0.6	
1473	1889	....do	....do		60.8	Food same as No. 1459, with 2,938 cc. water and tea.	5	28.0	27.2	1.3	—0.5	
1474	1889	....do	Student (N.)		57.6	Food same as No. 1459, with 3,659 cc. water and tea.	5	27.7	22.5	2.9	+2.3	
1475	1889	....do	....do		56.7	Food same as No. 1459, with 1,386 cc. water and tea.	5	28.2	22.8	2.1	+3.3	
1476	1889	....do	....do		58.3	Food same as No. 1459, with 3,659 cc. water and tea.	5	28.7	25.2	2.3	+1.2	

Nos. 1447–1449. Influence of copious water drinking on nitrogen, metabolism, and assimilation in healthy individuals. Inaug. Diss. (Russian), St. Petersburg, 1886, p. 40, Table 1. Nos. 1450–1452. Ibid., p. 42, Table 2. Nos. 1453–1455. Ibid., p. 44, Table 3. Nos. 1456–1458. Ibid., p. 46, Table 4. Nos. 1459–1476. Vrach, 10, p. 453.

Nos. 1447–1458 were made by Ter-Grigorianz in St. Petersburg in 1886. The object was to investigate the influence of drinking large quantities of water on the metabolism and assimilation of nitrogen in healthy subjects. Four experiments of 21 days' duration were made with healthy subjects. The experiments were divided in three periods of 7 days each. In the first period the subjects consumed no water and were limited to known quantities of liquids in the form of tea, milk, and soup. In the second period they were given 150 cubic centimeters of water (of room temperature) 8 times per day. In the third period the quantity of water consumed was doubled.

The food consisted of white bread, beef tea, roast meat, milk, potatoes, and tea. The diet was uniform throughout the experiments. The nitrogen in the food, urine, and feces was determined by the Kjeldahl method. The amount of urine, its specific gravity, and nitrogen content were determined every 12 hours. The urine excreted from 8 o'clock in the morning to 8 o'clock in the evening was taken as representing the day urine; and the remainder, from 8 o'clock at night until 8 o'clock in the morning, as representing the night urine. The feces were separated with blackberries, and the nitrogen content was determined at each defecation. During the whole time of the experiments the subjects followed their ordinary occupations.

The following conclusions were reached: When large quantities of water were consumed, the metabolism of nitrogen increased and in general the assimilation of nitrogen decreased, although there were some exceptions; the amount of urine was increased and the nitrogen content of the day urine was higher than that of the night urine; the weight of the subjects also increased. (See also No. 878, Table 11.)

Nos. 1459–1476 were made by Karchagin in St. Petersburg in 1889. The object was to investigate the influence of diminished drinking of water on the assimilation and metabolism of nitrogen in healthy persons. The subjects were 6 healthy medical students, 20 to 25 years old. Each experiment was divided into three periods of 5 days each. The food consisted of boiled meat, beef tea, plum butter, milk, white bread, tea, and water. Some of the subjects did not take milk, and some took, besides the food indicated, red bilberry jelly. The periods differed only in the quantities of water drunk. In the first and third periods a normal quantity was allowed, and in the second a limited quantity. In some of the food materials (bread, boiled meat, and red bilberry jelly), the author determined the percentage of water, and in the others it was calculated from König's figures. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method, and the uric acid in the urine by Haycraft's method.

The following conclusions were reached: When the quantities of water consumed were less than the normal amount, the weight of the body diminished considerably; the quantity of urine decreased and its specific gravity increased; the assimilation of nitrogen improved somewhat; and the metabolism of nitrogen was lowered qualitatively and quantitatively, though inconsiderably. The subjects did not feel as well as usual.

On returning to the normal quantities of water, the weight of the body increased, though in some cases the normal weight was not reached in 5 days. In some cases, however, the weight increased beyond normal. The quantitative metabolism was improved as compared with metabolism under normal conditions, while the qualitative metabolism remained below normal. After a short time the subjects felt as well as usual.

EXPERIMENTS IN WHICH THE SUBJECTS BREATHED COMPRESSED AIR.

In Table 16 are included 9 tests with men in which the subjects for a part of the day lived in an atmosphere of more than normal pressure. The other conditions were normal.

TABLE 16.—*Experiments on the influence of compressed air.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1477	1889	Shmitz	Observer		67.6	264 gm. bread, 114 gm. meat, 357 gm. bouillon, 129 gm. milk, 1,771 cc. water.	7	8.9	5.1	0.8	+3.0	
1478	1889	do	do		67.7	239 gm. bread. 182 gm. meat, 429 gm. bouillon, 171 gm. milk, 1,669 cc. water.	7	11.1	4.9	0.9	+5.3	Breathing compressed air.
1479	1889	do	do		67.6	356 gm. bread, 134 gm. meat, 301 gm. bouillon, 229 gm. milk, 1,571 cc. water.	7	11.3	7.8	0.9	+2.6	
1480	1889	do	Hospital servant (M.)		58.0	557 gm. bread, 286 gm. meat, 900 gm. bouillon, 1,671 cc. water.	7	16.3	6.3	2.7	+7.3	
1481	1889	do	do		58.2	571 gm. bread, 243 gm. meat, 909 gm. bouillon, 1,736 cc. water.	7	15.2	6.1	1.6	+7.5	Do.
1482	1889	do	do		59.2	457 gm. bread, 143 gm. meat, 901 gm. bouillon, 1,610 cc. water.	7	10.8	8.9	1.5	+0.4	
1483	1889	do	Hospital servant (N.)		67.7	256 gm. bread, 131 gm. meat, 357 gm. bouillon, 104 gm. milk, 1,666 cc. water.	7	9.3	6.3	1.0	+2.0	
1484	1889	do	do		68.0	286 gm. bread, 171 gm. meat, 514 gm. bouillon, 129 gm. milk.	7	11.5	4.5	1.1	+5.9	Do.
1485	1889	do	do		68.3	300 gm. bread, 171 gm. meat, 514 gm. bouillon, 114 gm. milk, 2,000 cc. water.	7	11.5	9.9	1.1	+0.5	

Nos. 1477–1479. Vrach, 10, p. 395, Table 1. Nos. 1480–1482. Ibid., Table 2. Nos. 1483–1485. Ibid., Table 3.

Nos. 1477–1485 were made by Shmitz in St. Petersburg in 1889. The object was to investigate the influence of compressed air on the metabolism and assimilation of nitrogen. Several caissons or air-tight chambers under water, used in building a railroad bridge over the river Oufa in 1886 and 1887, were employed for these experiments. The maximum and minimum pressure of air in the chambers was 1.8 to 1.5 atmospheres in addition to the prevailing barometric pressure. The subjects were the author and two hospital servants. The food consisted of bread, meat, and bouillon. Sometimes milk was consumed also. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. Each experiment lasted 3 weeks and was divided into three equal periods, the first and third under normal conditions. During the second period the subjects remained in the caissons in the compressed air 3 hours a day.

The author sums up the results of his experiments as follows: The metabolism of nitrogen was lowered by remaining in an atmosphere of compressed air and increased very markedly upon a return to normal conditions. The assimilation of nitrogen improved slightly under the influence of compressed air (nearly 3 atmospheres). In 2 cases the appetite improved during the second period and also during the third period. The weight of the body increased during the whole experiment with each subject.

Another and more recent series of experiments by Schmitz[1] on the same subject was received too late for insertion in full in this compilation. The subjects were a man, a hospital servant, 36 years old, and 3 boys, each about 15 years old. The experiment was divided into 3 periods of 6 or 7 days each. During the second period the subjects spent 6 hours of each day in caissons used in the construction of a bridge on the river Ishim. The air in the caissons was under pressure of 2¼ atmospheres. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. In the author's opinion the results indicate that the metabolism and assimilation of protein increased with increased atmospheric pressure and varied directly with the amount of food consumed. The more complete assimilation of protein is regarded as an indication of the importance of atmospheric oxygen in the oxidation processes of the body. The experiments are also discussed from a medical standpoint.

In view of the limited number of experiments on this and closely related problems, the following brief abstracts of work very recently published are given: von Terray[2] made a number of experiments with a rabbit and a dog on the effect of variation in the oxygen content of the air on metabolism. The nitrogen in the food, urine, and feces was determined. Intermediate metabolic products in the urine, namely, lactic and oxalic acids, were also studied. The inspired oxygen and expired carbon dioxid were measured by means of a small respiration apparatus. In the author's opinion within wide limits metabolism, as a whole, is not influenced by the composition of the inspired air. In the experiment reported when the air contained 10.5 to 87 per cent of oxygen no effect on the mechanical processes of respiration or the excretion of nitrogen and carbon dioxid was observed. Below or above these limits effects of varying intensity were noticed. When the oxygen content of the air was less than 10.5 per cent the tissues apparently did not receive the necessary amount of oxygen, and symptoms of asphyxia occurred. The amount of oxygen assimilated diminished and the carbon dioxid excretion and the respiratory quotient increased, while the urine contained more nitrogen than was consumed in the food and the amount of intermediate metabolic products in it increased.

The influence of rarefied air, i. e., diminished atmospheric pressure, was studied by Lewinstein[3]. The experiments were made with rabbits. The subjects died in

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[1] The influence of increased atmospheric pressure on the metabolism and assimilation of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1895.

[2] Pflüger's Arch., 65 (1897), p. 393.

[3] Ibid., p. 278.

from 2 to 3 days when confined in an atmosphere of 300 to 400 millimeters pressure. This corresponds to an altitude of 5,000 to 7,000 meters. The rabbits were dissected and changes in the organs and tissues noted.

The influence of rarefied air and the air of high altitudes on the metabolism of man was studied by A. Loewy, J. Loewy, and L. Zuntz.[1] Experiments in which the respiratory quotient was determined were made in Berlin. The subjects were confined in a small chamber with an atmospheric pressure less than normal. They were made under various conditions of rest and work. The work was measured by a specially constructed apparatus. The conclusion was reached that when muscular work was performed the diminished atmospheric pressure did not change the amount of oxygen consumed from the air. When no work was performed the respiratory quotient was unaffected by diminished pressure. A number of experiments in which the respiratory quotient was determined were also made under various conditions of rest and work with three subjects on Monta Rosa in the Alps, and the results compared with the experiments made in Berlin. In the author's opinion the experiments showed that the air of high regions had a different effect from rarefied air when the diminished pressure is brought about by mechanical means. Rarefied air causes little if any change in metabolism during rest or work. The air of high regions, however, increases the general metabolism. The experiments are discussed at length.

[1] Pflüger's Arch., 66 (1897), p. 477.

DISEASED SUBJECTS.

The second main group includes the experiments with man in which the subjects were suffering from some disease. These experiments number about 750, or one-third of the entire number with man which have been collected.

The term "disease" is used in a restricted sense to indicate a pathological condition of organs, tissues, or functions of the body, and not those conditions which are simply abnormal or the result of accident.

In general the experiments have been so subdivided in the compilation that those in which the subjects were suffering from the same disease form classes by themselves. In several instances, however, when the same observer made experiments with subjects with different diseases all have been included in the group to which the greatest number belonged. Experiments made with normal subjects for purposes of comparison have also been included in a number of cases.

In classifying the diseases, Osler's Principles and Practice of Medicine has been followed in the main. The largest class includes the experiments with specific infectious diseases. The classes including constitutional diseases and diseases of the kidneys are next in point of numbers.

In the greater number of the experiments with diseased subjects the object was to study the influence of the disease on metabolism, usually the metabolism of nitrogen. In a few instances the effect on metabolism of the special medical treatment followed was studied.

The experiments with diseased subjects are interesting in themselves. They are in many cases of the utmost value in determining what foods are useful and what harmful in different pathological conditions. As an instance may be cited the investigations carried on to learn the effect of protein, fat, and carbohydrates in different combinations on the treatment of diabetes. The subject as a whole is perhaps the most important in the study of invalid dietetics. Experiments under pathological conditions are also of use in drawing deductions concerning nonpathological conditions. For instance, diseased subjects are often in a condition of more or less complete fasting. By comparing the phenomena of metabolism under such conditions with those of a healthy subject fasting and fed it is possible to draw deductions concerning metabolism under the latter conditions.

EXPERIMENTS WITH SUBJECTS WITH SPECIFIC INFECTIOUS DISEASES.

In Table 17 are included 351 tests with men, 8 with women, and 14 with children in which the subjects were suffering from typhoid fever, relapsing fever, syphilis, or phthisis. In these experiments special questions were usually studied; for instance, the effect of the disease upon the metabolism and assimilation of nitrogen, or the effect of a particular diet on the condition of the subject.

TABLE 17.—*Experiments with subjects with specific infectious diseases.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1486	1877	Renk	Man			Milk, eggs, meat, etc	20	12.6	12.0	2.0	— 1.4	Convalescence from typhoid fever.
1487	1879	Röhmann	Man (K.)	19		Milk, coffee, bread	15					Ileo typhus. NaCl in food, 3.0 gm.; in urine, 3.9 gm.; in feces, 0; loss, 0.9 gm.
1488	1882	Hoesslin	Man No. 7269 (7265)			Practically fasting (1,583 gm. soup)	3	0.0	13.5	0.5	—14.0	Typhus abdominalis.
1489	1882	do	Man No. 9			Fasting	1	0.0	12.7	0.9	—13.6	Do.
1490	1882	do	Man No. 7262			29 egg yolks, 2,500 gm. soup	1	13.6	15.7	1.1	— 3.2	Do.
1491	1882	do	Man No. 7974 (1947)			1,994.2 gm. porridge from coarse flour	4	12.3	15.0	2.2	— 4.9	Do.
1492	1882	do	Man No. 1947			1,566.7 gm. meat extract (Succis carnis sec expressus).	3	15.0	22.6	1.2	—18.8	Do.
1493	1882	do	Man No. 7426			Practically fasting (1,250 gm. soup)	2	0.0	13.2	0.4	—13.6	Do.
1494	1882	do	do			395.3 gm. ham	4	15.0	19.9	0.9	— 5.8	Do.
1495	1882	do	Man No. 7513 (7575)			Fasting	3	0.0	14.9	0.5	—15.4	Do.
1496	1882	do	Man No. 7573 (7575)			100 gm. rice	2	2.5	11.3	0.5	— 9.3	Do.
1497	1882	do	do			24 egg yolks	4	11.2	17.4	0.8	— 7.0	Do.
1498	1882	do	do			3,000 gm. milk	2	19.9	10.9	0.4	+ 7.6	Do.
1499	1882	do	do			976 gm. white of egg	2	19.8	18.0	1.2	+ 0.6	Do.
1500	1882	do	do			3,777.8 gm. porridge from coarse flour, 300 gm. wine.	4	22.5	17.8	1.6	+ 3.1	Do.
1501	1882	do	Man No. 6985			1,750 gm. milk	1	12.6	15.1	0.8	— 3.3	Do.
1502	1882	do	do			1,400 gm. meat extract, 500 gm. soup, 400 gm. wine.	1	12.8	21.1	0.5	— 8.8	Do.
1503	1882	do	Man No. 6879			1,750 gm. milk	1	12.2	21.6	0.9	—10.3	Do.
1504	1882	do	do			471 gm. ham	1	21.8	19.4	2.2	+ 0.2	Do.
1505	1882	do	Man No. 6996			1,500 gm. milk	1	12.2	17.6	1.2	— 6.6	Do.
1506	1882	do	do			494 gm. ham	1	22.9	19.6	2.1	+ 1.2	Do.
1507	1883	Zasietski	(Man (Z.)	27		1,009 gm. milk, 667 cc. water	3	5.7	17.5	0.8	—12.6	Typhus exanthematicus, fever; 4 baths per day.
1508	1883	do	do	27		1,300 gm. milk, 547 cc. water	3	7.5	19.5	1.2	—13.2	Typhus exanthematicus, fever.
1509	1883	do	do	27		2,087 gm. milk, 127 cc. water	3	12.5	14.9	0.9	— 3.3	Twenty-eight days after fever subsided.
1510	1883	do	Man (P.)	19		1,851 gm. milk, 157 cc. water	3	10.4	16.5	2.1	— 8.2	Typhus exanthematicus, fever; 4 baths per day.

1511	1883	.....do	.....do	19	....	1,837 gm. milk, 290 cc. water	3	10.6	20.0	2.6	—12.0	Typhus exanthematicus, fever.
1512	1883	.....do	.....do	19	....	3,143 gm. milk, 83 cc. water	3	18.9	15.4	1.4	+ 2.1	Thirty-five days after fever subsided.
1513	1883	.....do	Man (F.)	18	....	2,110 gm. milk, 680 cc. water	3	12.5	20.4	2.0	— 9.9	Typhus exanthematicus, fever; 4 baths per day.
1514	1883	.....do	.....do	18	....	2,082 gm. milk, 843 cc. water	3	13.0	22.5	2.4	—11.9	Typhus exanthematicus, fever.
1515	1883	.....do	.....do	18	....	3,425 gm. milk, 93 cc. water	3	20.3	16.4	1.7	+ 2.2	Twenty-five days after fever subsided.
1516	1883	.....do	Man (K.)	18	....	2,037 gm. milk, 425 cc. water	3	11.4	13.0	1.9	— 3.5	Typhus exanthematicus, fever; 4 baths per day.
1517	1883	.....do	.....do	18	....	2,340 gm. milk, 333 cc. water	3	13.5	16.1	3.1	— 5.7	Typhus exanthematicus, fever.
1518	1883	.....do	.....do	18	....	3,817 gm. milk, 140 cc. water	3	21.6	16.3	1.4	+ 3.9	Thirty days after fever subsided.
1519	1883	.....do	Man (V.)	17	....	1,830 gm. milk, 860 cc. water	3	10.4	17.1	1.9	— 8.6	Typhus exanthematicus, fever.
1520	1883	.....do	.....do	17	....	1,983 gm. milk, 717 cc. water	3	11.2	14.8	1.5	— 5.1	Typhus exanthematicus, fever; 4 baths per day.
1521	1883	.....do	.....do	17	....	3,177 gm. milk, 243 cc. water	3	17.9	14.1	0.9	+ 2.9	Twenty-eight days after fever subsided.
1522	1883	.....do	Man (K.)	25	....	3,033 gm. milk, 740 cc. water	3	17.6	16.1	2.2	— 0.7	Typhus exanthematicus, fever.
1523	1883	.....do	.....do	25	....	2,957 gm. milk, 710 cc. water	3	16.2	13.8	1.6	+ 0.8	Typhus exanthematicus, fever; 4 baths per day.
1524	1883	.....do	.....do	25	....	4,293 gm. milk, 263 cc. water	3	25.9	13.6	1.4	+10.9	Twenty-five days after fever subsided.
1525	1883	.....do	Man (B.)	29	....	2,077 gm. milk, 383 cc. water	3	13.0	21.3	1.0	— 9.3	Typhus exanthematicus, fever.
1526	1883	.....do	.....do	29	....	2,067 gm. milk, 187 cc. water	3	12.7	14.4	0.8	— 2.5	Typhus exanthematicus, fever; 4 baths per day.
1527	1883	.....do	.....do	29	....	4.110 gm. milk, 157 cc. water	3	24.5	11.9	1.4	+11.2	Twenty-seven days after fever subsided.
1528	1883	.....do	Man (O.)	42	....	887 gm. milk, 720 cc. water	3	5.2	13.4	0.8	— 9.0	Typhus exanthematicus, fever.
1529	1883	.....do	.....do	42	....	603 gm. milk, 590 cc. water	3	5.8	12.1	0.7	— 7.0	Typhus exanthematicus, fever; 4 baths per day.
1530	1883	.....do	.....do	42	....	3,120 gm. milk, 183 cc. water	3	17.6	14.8	1.0	+ 1.8	Thirty days after fever subsided.
1531	1883	.....do	Man (G.)	23	....	1,087 gm. milk, 333 cc. water	3	6.6	19.4	1.1	—13.5	Typhus exanthematicus, fever.
1532	1883	.....do	.....do	23	....	1,027 gm. milk, 3,713 cc. water	3	6.0	16.6	0.7	—11.3	Typhus exanthematicus, fever; 4 baths per day.
1533	1883	.....do	Man (K.)	20	....	1,007 gm. milk, 553 cc. water	3	5.8	17.7	0.8	—12.7	Typhus exanthematicus, fever. Subject was given quinin.
1534	1883	.....do	.....do	20	....	1,085 gm. milk, 470 cc. water	3	6.1	19.6	0.9	—14.4	Typhus exanthematicus, fever.
1535	1883	.....do	.....do	20	....	2,703 gm. milk, 170 cc. water	3	14.7	14.7	0.8	— 0.8	Twenty-seven days after fever subsided.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1536	1883	Zasietski	Man (A.)	26	......	1,807 gm. milk, 690 cc. water	3	10.2	18.4	1.0	— 9.2	Typhus exanthematicus, fever. Subject was given quinin.
1537	1883	....do	....do	26	......	1,703 gm. milk, 583 cc. water	3	9.6	18.1	0.9	— 9.4	Typhus exanthematicus, fever.
1538	1883	....do	Boy (S.)	15	......	1,873 gm. milk, 277 cc. water	3	10.7	15.2	1.2	— 5.7	Do.
1539	1883	....do	....do	15	......	1,877 gm. milk, 237 cc. water	3	10.5	11.6	1.0	— 2.1	Typhus exanthematicus, fever. Subject was given quinin.
1540	1883	....do	Man (F.)	37	......	1,362 gm. milk, 603 cc. water	3	7.7	12.0	1.1	— 5.4	Febris recurrens, fever.
1541	1883	....do	....do	37	......	1,307 gm. milk, 307 cc. water	3	7.5	11.8	1.0	— 5.3	Febris recurrens, fever. Subject was given quinin.
1542	1883	....do	Man (K.)	25	......	2,010 gm. milk, 125 cc. water	2	10.7	15.0	1.4	— 5.7	Typhus exanthematicus, fever.
1543	1883	....do	....do	25	......	2,158 gm. milk, 90 cc. water	2	11.1	12.5	1.3	— 2.7	Typhus exanthematicus, fever. Subject was given sodium salicylate.
1544	1883	....do	....do	25	......	3,020 gm. milk, 350 cc. water	2	17.8	10.6	0.7	+ 6.5	Sixteen days after fever subsided.
1545	1883	....do	Boy (I.)	14	......	995 gm. milk, 805 cc. water	2	5.7	19.5	0.8	—14.6	Typhus exanthematicus, fever.
1546	1883	....do	....do	14	......	985 gm. milk, 885 cc. water	2	5.5	17.9	0.6	—13.0	Typhus exanthematicus, fever. Sodium salicylate given.
1547	1886	Khadgi	Copyist (Zh.)	23	61.0	991 cc. milk, 98 gm. bread	7	7.3	14.9	1.8	— 9.4	Typhus abdominalis, fever period.
1548	1886	....do	....do	23	63.9	1,900 cc. milk, 762 gm. bread	3	19.5	15.9	2.1	+ 1.5	No fever, convalescence.
1549	1886	....do	Soldier (D.)	24	60.5	1,111 cc. milk, 155 gm. bread, 21 gm. meat, 92 gm. broth (2 days).	9	9.3	18.9	1.5	—11.1	Typhus abdominalis, fever.
1550	1886	....do	....do	24	65.2	1,286 cc. milk, 1,004 gm. bread, 91 gm. meat	4	27.0	19.1	2.8	+ 5.1	No fever, convalescence.
1551	1886	....do	Soldier (A.)	22	54.8	1,345 cc. milk, 701 gm. bread	12	12.6	16.4	2.8	— 6.6	Typhus abdominalis, fever.
1552	1886	....do	....do	22	58.9	2,099 cc. milk, 955 gm. bread	5	12.7	17.4	4.6	— 9.3	No fever, convalescence.
1553	1886	....do	Soldier (P.)	22	52.1	1,346 cc. milk, 331 gm. bread	12	11.7	15.2	1.0	— 4.5	Typhus abdominalis, fever.

1554	1886	.....do	.....do	22	55.0	2,085 cc. milk, 969 gm. bread	5	26.4	18.2	2.6	+ 5.6	No fever, convalescence.
1555	1886	.....do	Accountant (B.)	26	56.1	714 cc. milk, 154 gm. bread, 65 gm. meat, 75 gm. broth.	9	8.6	15.7	1.4	— 8.5	Typhus abdominalis, fever.
1556	1886	.....do	.....do	26	57.7	660 cc. milk, 643 gm. bread	4	24.1	17.7	1.9	+ 4.5	No fever, convalescence.
1557	1886	.....do	Soldier (B.)	24	67.4	703 cc. milk, 86 gm. bread, 42 gm. meat, 149 gm. broth.	6	6.7	18.0	3.1	—14.4	Typhus abdominalis, fever.
1558	1886	.....do	Soldier (K.)	22	58.8	897 cc. milk, 256 gm. bread, 72 gm. meat, 227 gm. broth.	10	12.5	18.1	2.0	— 7.6	Do.
1559	1886	.....do	.....do	22	61.1	745 cc. milk, 590 gm. bread, 115 gm. meat, 237 gm. broth.	6	20.2	20.1	3.1	— 3.0	No fever, convalescence.
1560	1886	.....do	Soldier (Z.)	23	31.0	790 cc. milk, 103 gm. bread, 74 gm. meat, 187 gm. broth.	12	9.7	12.9	0.9	— 4.1	Typhus abdominalis, fever.
1561	1886	.....do	.....do	23	53.2	872 cc. milk, 688 gm. bread, 116 gm. meat, 248 gm. broth.	6	20.2	15.1	3.3	+ 1.8	No fever, convalescence.
1562	1886	.....do	Soldier (P.)	23	68.0	874 cc. milk, 112 gm. bread, 72 gm. meat, 200 gm. broth.	4	9.1	16.5	1.2	— 8.6	Fever (typhus abdominalis (?), not well characterized).
1563	1886	.....do	.....do	23	68.1	759 cc. milk, 467 gm. bread, 106 gm. meat, 272 gm. broth.	5	15.4	14.2	1.0	+ 0.2	No fever, convalescence.
1564	1889	Müller	Woman	20	38.0	1,000 gm. milk, 66.2 gm. bread (Zwieback), 79.7 gm. meat, 302.1 gm. coffee (1,165 calories).	7	9.9	7.5	1.1	+ 1.3	Fever.
1565	1890	Diakonov	Man	......	57.0	44 gm. bread, 991 gm. milk	4	4.2	21.3	1.1	—18.2	Typhoid fever.
1566	1890	.....do	.....do	......	53.8	29 gm. bread, 1,030 gm. milk, 50 cc. alcohol	4	5.2	20.8	1.9	—17.5	Do.
1567	1890	.....do	Man	......	67.7	121 gm. bread, 983 gm. milk	4	7.3	17.3	2.4	—12.4	Do.
1568	1890	.....do	.....do	......	65.3	138.6 gm. bread, 961 gm. milk, 50 cc. alcohol	4	8.0	16.1	3.1	—11.2	Do.
1569	1890	.....do	.....do	......	63.0	199 gm. bread, 1,000 gm. milk	4	9.1	14.9	1.8	— 5.6	Do.
1570	1890	.....do	Man	......	45.2	52.4 gm. bread, 1,060 gm. milk	4	7.1	17.5	1.1	—11.5	Do.
1571	1890	.....do	.....do	......	44.0	40.8 gm. bread, 1,183 gm. milk, 50 cc. alcohol.	4	6.0	17.3	2.9	—14.2	Do.
1572	1890	.....do	.....do	......	41.8	30.9 gm. bread, 872 gm. milk	4	4.9	14.7	0.9	—10.7	Do.
1573	1890	.....do	.....do	......	56.4	112.6 gm. bread, 1,088 gm. milk	4	7.1	19.3	2.0	—15.2	Do.
1574	1890	.....do	.....do	......	53.8	67.6 gm. bread, 969 gm. milk, 50 cc. alcohol	4	6.0	17.2	3.0	—14.2	Do.
1575	1890	.....do	.....do	......	51.4	83.4 gm. bread, 824 gm. milk	4	5.7	16.7	2.4	—13.4	Do.
1576	1890	.....do	.....do	......	51.5	61 gm. bread, 1,317 gm. milk	4	6.0	20.8	3.6	—18.4	Do.
1577	1890	.....do	Man	......	48.5	58.8 gm. bread, 1,039 gm. milk, 50 cc. alcohol	4	6.4	21.0	4.3	—18.9	Do.
1578	1890	.....do	.....do	......	46.5	58.4 gm. bread, 994 gm. milk	4	6.3	16.9	1.4	—12.0	Do.
1579	1890	.....do	.....do	......	49.7	113 gm. bread, 1,050 gm. milk	4	7.6	17.6	0.6	—10.6	Do.
1580	1890	.....do	.....do	......	48.7	120 gm. bread, 1,171 gm. milk, 50 cc. alcohol	4	8.0	15.0	0.8	— 7.8	Do.
1581	1890	.....do	.....do	......	47.4	141 gm. bread, 1,161 gm. milk	4	8.1	13.3	0.7	— 5.9	Do.
1582	1890	.....do	Man	......	55.1	32 gm. bread, 760 gm. milk, 50 cc. alcohol	4	4.9	17.2	2.1	—14.4	Do.
1583	1890	.....do	.....do	......	52.4	95.6 gm. bread, 988 gm. milk	4	6.8	13.3	0.7	— 7.2	Do.
1584	1890	Matzkevich	Soldier (K.)	22	63.6	75 gm. bread, 1,125 cc. milk, 300 gm. bouillon, 170 gm. Stoke's mixture, 300 cc. coffee, 1,000 cc. water.	4	6.1	12.7	1.6	— 8.2	Ileo typhus. Two or three baths per day.
1585	1890	.....do	.....do	22	61.2	109 gm. bread, 3,500 cc. milk, 262 gm. bouillon, 155 gm. Stoke's mixture, 300 cc. coffee, 2,420 cc. water.	4	6.6	13.6	1.1	— 8.1	Do.
1586	1890	.....do	.....do	22	59.6	93 gm. bread, 1,200 cc. milk, 300 gm. bouillon, 187 gm. Stoke's mixture, 300 cc. coffee (1 day), 2,200 cc. water.	4	6.6	15.3	1.0	— 9.7	
1587	1890	.....do	.....do	22	58.8	98 gm. bread, 1,150 cc. milk, 300 gm. bouillon, 180 gm. Stoke's mixture, 1,200 cc. water.	4	7.1	15.4	1.6	— 9.9	

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1588	1890	Matzkevich	Soldier (S.)	22	58.3	99 gm. bread, 1,040 cc. milk, 300 gm. bouillon, 180 gm. Stoke's mixture, 367 cc. coffee, 457 cc. water.	4	7.8	12.4	1.6	— 6.2	Ileo typhus. Two or three baths per day.
1589	1890	....do	....do	22	55.8	114 gm. bread, 1,217 cc. milk, 300 gm. bouillon, 160 gm. Stoke's mixture, 300 cc. coffee, 1,650 cc. water.	4	8.6	16.2	1.3	— 8.9	
1590	1890	....do	....do	22	54.4	122 gm. bread, 1,280 cc. milk, 250 gm. bouillon 115 gm. Stoke's mixture, 2,400 cc. water.	4	8.0	16.1	0.9	— 9.0	
1591	1890	....do	....do	22	53.4	72 gm. bread, 1,050 cc. milk, 300 gm. bouillon, 165 gm. Stoke's mixture, 1,550 cc. water.	4	6.9	14.4	1.9	— 9.4	
1592	1890	....do	....do	22	51.8	94 gm. bread, 753 cc. milk, 260 gm. bouillon, 165 gm. Stoke's mixture, 1,125 cc. water.	4	6.0	13.0	1.5	— 8.5	
1593	1890	....do	....do	22	50.8	129 gm. bread, 252 cc. milk, 300 gm. bouillon, 160 gm. Stoke's mixture, 1,550 cc. water.	4	7.3	13.0	2.2	— 7.9	
1594	1890	....do	Soldier (K.)	23	67.3	98 gm. bread, 1,100 cc. milk, 250 gm. bouillon, 160 gm. Stoke's mixture, 200 cc. coffee, 575 cc. water.	4	7.9	13.7	1.4	— 7.2	Do.
1595	1890	....do	....do	23	66.0	84 gm. bread, 1,044 cc. milk, 300 gm. bouillon, 150 gm. Stoke's mixture, 200 cc. coffee (2 days), 2,125 cc. water.	4	6.6	13.2	0.8	— 7.4	
1596	1890	....do	....do	23	65.3	114 gm. bread, 1,148 cc. milk, 288 gm. bouillon, 170 gm. Stoke's mixture.	4	7.6	14.7	0.8	— 7.9	
1597	1890	....do	....do	23	65.4	193 gm. bread, 286 gm. manna gruel (2 days), 273 gm. cutlet (2 days), 300 gm. bouillon, 180 gm. Stoke's mixture, 1,500 cc. water.	4	8.0	14.3	1.0	— 7.3	
1598	1890	....do	....do	23	65.8	231 gm. bread, 300 gm. bouillon, 239 gm. cutlet, 2,700 cc. water.	4	8.3	14.4	1.3	— 7.4	
1599	1890	....do	Baker's driver (I.)	18	49.3	39 gm. bread, 300 gm. bouillon, 1,153 cc. milk, 100 gm. Stoke's mixture, 300 gm. coffee, 450 cc. water.	4	7.2	8.8	2.4	— 4.0	Do.
1600	1890	....do	....do	18	47.7	92 gm. bread, 250 gm. bouillon, 1,017 cc. milk, 121 gm. Stoke's mixture, 2,162 cc. water.	4	6.9	12.5	0.8	— 6.4	
1601	1890	....do	....do	18	45.1	168 gm. bread, 300 gm. bouillon. 1,088 cc. milk, 165 gm. Stoke's mixture, 175 cc. coffee, 2,300 cc. water.	4	8.5	15.0	0.7	— 7.2	

1602	1890	.....do	.....do	18	45.8	221 gm. bread, 300 gm. bouillon, 980 cc. milk, 128 gm. Stoke's mixture, 208 gm. manna gruel, 2,140 cc. water.	5	9.3	15.5	1.4	— 7.6	
1603	1890	.....do	Blacksmith's apprentice.	14	32.4	83 gm. bread, 250 gm. bouillon, 800 cc. milk, 89 gm. Stoke's mixture, 300 cc. coffee (1 day), 540 cc. water.	4	6.1	8.9	0.9	— 3.7	Do.
1604	1890	.....do	.....do	14	32.6	169 gm. bread, 283 gm. bouillon, 1,175 cc. milk, 98 gm. Stoke's mixture, 2.240 cc. water.	4	9.1	12.2	1.4	— 4.5	
1605	1890	.....do	.....do	14	33.5	211 gm. bread, 300 gm. bouillon, 302 gm. manna gruel, 54 gm. egg, 2,460 cc. water.	4	8.3	11.1	1.8	— 4.6	
1606	1890	.....do	.....do	14	34.6	244 gm. bread, 300 gm. bouillon, 261 gm. manna gruel, 61 gm. egg, 1,260 cc. water.	4	7.7	11.4	1.7	— 5.4	
1607	1890	.....do	Waiter (M.)	26	53.7	89 gm. bread, 263 gm. bouillon, 1,025 cc. milk, 178 gm. Stoke's mixture, 525 cc. water.	4	7.4	10.5	1.8	— 4.9	Do.
1608	1890	.....do	.....do	26	52.1	114 gm. bread, 300 gm. bouillon, 1,105 cc. milk, 2,625 cc. water, 173 gm. Stoke's mixture, 214 gm. manna gruel.	4	7.4	13.7	0.6	— 6.9	
1609	1890	.....do	.....do	26	51.1	190 gm. bread, 300 cc. bouillon, 1,680 cc, water, 42 gm. Stoke's mixture, 140 gm. manna gruel.	3	5.8	11.4	1.8	— 7.4	
1610	1890	.....do	Peasant (M.)	18	39.0	28 gm. bread, 45 gm. vodka (2 days), 750 cc. milk, 180 gm. Stoke's mixture (2 days), 600 cc. water.	4	3.6	7.7	0.8	— 4.9	Do.
1611	1890	.....do	.....do	18	37.4	42 gm. bread, 850 cc. milk, 130 gm. Stoke's mixture, 2,250 cc. water.	4	6.2	15.6	1.1	—10.5	
1612	1890	.....do	.....do	18	36.7	81 gm. bread, 850 cc. milk, 126 gm. Stoke's mixture, 1,500 cc. water.	4	6.5	16.2	1.0	—10.7	
1613	1890	.....do	.....do	18	35.5	80 gm. bread, 254 gm. manna gruel, 900 cc. milk, 31 gm. Stoke's mixture, 1,650 cc. water.	4	9.0	14.0	1.0	— 6.0	
1614	1890	.....do	Soldier (V.)	25	63.0	129 gm. bread, 300 cc. bouillon, 798 cc. milk, 20 gm. meat powder (2 days), 2,500 cc. water.	4	8.1	14.2	1.4	— 7.5	Do.
1615	1890	.....do	.....do	25	61.0	221 gm. bread, 300 cc. bouillon, 863 cc. milk, 40 gm. meat powder (2 days), 2.250 cc. water.	4	14.7	16.2	1.6	— 3.1	
1616	1890	.....do	.....do	25	61.5	214 gm. bread, 300 cc. bouillon (2 days), 1,112 cc. milk, 50 gm. meat powder, 2,175 cc. water.	4	17.3	16.2	1.5	— 0.4	
1617	1890	.....do	.....do	25	62.7	226 gm. bread, 267 gm. cutlet, 1,100 cc. milk, 1,600 cc. water.	3	16.7	18.9	1.5	— 3.4	
1618	1890	Gruzdiev	Soldier (K.)	22	45.2	22 gm. bread, 133 cc. milk, 215 cc. water, (2 days) + 1,266 cc. water in food.	5	14.9	32.7	1.9	—19.7	Phthisis. Moderate water drinking.
1619	1890	.....do	.....do	22	44.2	41 gm. bread, 923 cc. milk, 2,050 cc. water + 2,849 cc. water in food.	5	10.9	29.6	1.8	—20.5	Phthisis. Copious water drinking.
1620	1890	.....do	Student (Kh.)	17	45.0	39 gm. bread, 2,295 cc. milk, 615 cc. water + 2,621 cc. water in food.	5	25.5	39.3	5.3	—19.1	Inflammation of the lungs. Moderate water drinking.
1621	1890	.....do	.....do	17	44.2	80 gm. bread, 1,672 cc. milk, 2,209 cc. water + 3,600 cc. water in food.	5	20.0	37.0	3.7	—20.7	Inflammation of the lungs. Copious water drinking.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1622	1890	Gruzdiev	Soldier (Ya.)	23	52.7	199 gm. bread, 2,860 cc. milk, 168 cc. water +2,774 cc. water in food.	5	44.9	43.2	11.4	— 9.7	Typhus abdominalis. Moderate water drinking.
1623	1890	...do	...do	23	52.3	249 gm. bread, 1,700 cc. milk, 1,737 cc. water +3,340 cc. water in food.	5	31.4	37.6	4.3	—10.5	Typhus abdominalis. Copious water drinking.
1624	1890	...do	Student (S.)	20	41.8	195 gm. bread, 1,531 cc. milk, 210 cc. water (2 days) +1,478 cc. water in food.	5	26.3	33.1	2.2	— 9.0	Typhus abdominalis. Moderate water drinking.
1625	1890	...do	...do	20	41.2	549 gm. bread, 693 cc. milk, 1,650 cc. water +2,426 cc. water in food.	5	30.6	39.3	2.4	—11.1	Typhus abdominalis. Copious water drinking.
1626	1890	...do	Soldier (Ya.)	27	50.5	735 gm. bread, 1,103 cc. milk, 1,200 cc. water +2,217 cc. water in food.	5	19.2	32.7	3.1	—16.6	Do.
1627	1890	...do	...do	27	50.5	73 gm. bread, 898 cc. milk, 837 cc. water in food.	5	15.5	21.8	3.2	— 9.5	Typhus abdominalis. Moderate water drinking.
1628	1890	...do	Peasant (S.)	19	44.5	127 gm. bread, 972 cc. milk, 306 cc. water, +1,226 cc. water in food.	5	17.4	22.3	5.0	— 9.9	Do.
1629	1890	...do	...do	19	44.0	489 gm. bread, 897 cc. milk, 2,582 cc. water, +3,546 cc. water in food.	5	30.4	47.8	4.0	—20.4	Typhus abdominalis. Copious water drinking.
1630	1890	...do	Peasant (L.)	29	7.7	299 gm. bread, 858 cc. milk, 62 gm. meat (3 days), 1,386 cc. water +2,252 cc. water in food.	5	25.0	27.2	5.5	— 4.7	Phthisis. Copious water drinking.
1631	1890	...do	...do	29	55.3	30 gm. bread (1 day), 1,398 cc. milk, 49 gm. meat (2 days), 320 cc. water +1,349 cc. water in food.	5	19.3	20.4	4.4	— 5.5	Phthisis. Moderate water drinking.
1632	1890	...do	Soldier (Ch.)	21	52.6	978 gm. bread, 514 cc. milk, 42 gm. meat (3 days), 1,624 cc. water +2,167 cc. water in food.	5	14.8	30.1	2.8	—18.1	Typhus abdominalis. Copious water drinking.
1633	1890	...do	...do	21	47.7	97 gm. bread, 1,072 cc. milk, 57 gm. meat, 187 cc. water (3 days), +1,145 cc. water in food.	5	20.2	31.8	4.2	—15.8	Typhus abdominalis. Moderate water drinking.

1634	1890	Gramatchikov....	Soldier (B.).........	23	55.5	64 gm. bread, 1,741 cc. milk, 105 gm. meat. 300 gm. water.	4	13.0	18.0	3.7	—8.7	Fever. K in food 1.5 gm., in urine 0.8 gm., in feces 0.7 gm., gain or loss 0; Na in food 0.9 gm., in urine 0.1 gm., in feces 0.7 gm., gain 0.1 gm.; Ca in food 1.8 gm., in urine 0.5 gm., in feces 1.4 gm., loss 0.1 gm.; Mg in food 0.4 gm., in urine 0.2 gm., in feces 0.1 gm., gain 0.1 gm.; S in food 1.3 gm., in urine 0.7 gm., in feces 0.6 gm., gain or loss 0; P in food 0.8 gm., in urine 0.3 gm., in feces 0.5 gm., gain or loss 0.
1635	1890	.....do	.....do	23	53.6	256 gm. bread, 1,875 cc. milk, 189 gm. meat, 300 gm. water.	4	24.1	19.5	2.8	+1.8	Fever. K in food 2.1 gm., in urine 1.2 gm., in feces 1.0 gm., loss 0.1 gm.; Na in food 1.4 gm., in urine 0.9 gm., in feces 0.8 gm., loss 0.3 gm.; Ca in food 2.0 gm., in urine 0.3 gm., in feces 1.8 gm., loss 0.1 gm.; Mg in food 0.5 gm., in urine 0.2 gm., in feces 0.3 gm., gain or loss 0; S in food 1.5 gm., in urine 1.4 gm., in feces 0.6 gm., loss 0.5 gm.; P in food 1.0 gm., in urine 0.5 gm., in feces 0.6 gm., loss 0.9 gm.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1636	1890	Gramatchikov....	Soldier (B.).........	23	57.6	631 gm. bread, 192 gm. meat, 1,788 cc. milk, 1,500 cc. water.	4	26.2	16.6	2.6	+7.0	One month after No. 1635, no fever. K in food 2.9 gm., in urine 1.6 gm., in feces 0.3 gm., gain 1.0 gm.; Na in food 4.2 gm., in urine 2.6 gm., in feces 0.7 gm., gain 0.9 gm.; Ca in food 2.8 gm., in urine 0.3 gm., in feces 1.3 gm., gain 1.2 gm.; Mg in food 0.8 gm., in urine 0.3 gm., in feces 0.2 gm., gain 0.3 gm.; S in food 1.8 gm., in urine 1.4 gm., in feces 0.3 gm., gain 0.1 gm.; P in food 1.4 gm., in urine 0.6 gm., in feces 0.4 gm., gain 0.4 gm.
1637	1890	.....do............	Soldier (K.).........	23	58.9	384 gm. bread, 2,042 cc. milk, 600 gm. water..	6	16.6	19.0	3.2	—5.6	Fever. KCl in food 3.3 gm., in urine 3.0 gm., in feces 1 9 gm., loss 1.6 gm.; NaCl in food 3.7 gm., in urine 1.8 gm., in feces 2.4 gm., loss 0.5 gm.; CaO in food 3.1 gm., in urine 0.1 gm., in feces 2.7 gm., gain 0.3 gm.; MgO in food 0.7 gm., in urine 0.2 gm., in feces 0.4 gm., gain 0.1 gm.; SO_3 in food 4.8 gm., in urine 4.1 gm., in feces 1.3 gm., loss 0.6 gm.; P_2O_5 in food 5.3 gm., in urine 2.5 gm., in feces 3.8 gm., loss 1.0 gm.

1638	1890	.....do	.....do	23	67.5	811 gm. bread, 1,125 cc. milk, 159 gm. meat, 1,200 gm. water, 64 gm. sugar, 3.6 gm. salt.	4	30.7	20.9	2.0	+7.8	One month after No. 1637, no fever. KCl in food 4.1 gm., in urine 2.9 gm., in feces 3.8 gm., loss 2.6 gm.; NaCl in food 9.1 gm., in urine 7.7 gm., in feces 0.7 gm., gain or loss 0.7; CaO in food 2.2 gm., in urine 0.3 gm., in feces 1.2 gm., gain 0.6; MgO in food 0.8 gm., in urine 0.3 gm., in feces 0.3 gm., gain 0.2 gm.; SO_3 in food 4.9 gm., in urine 2.8 gm., in feces 0.5 gm., gain 1.6 gm.; P_2O_5 in food 5.6 gm., in urine 2.8 gm., in feces 1.4 gm., gain 1.4.
1639	1890	.....do	Soldier (Ch.)........	......	44.0	39 gm. bread, 2,294 cc. milk, 600 gm. water...	5	......	......	......	......	Fever. KCl in food 3.0 gm., in urine 2.7 gm., in feces 1.9 gm., loss 1.6 gm.; NaCl in food 2.4 gm., in urine 1.2 gm., in feces 1.5 gm., loss 0.3 gm.; CaO in food 3.6 gm., in urine 0.5 gm., in feces 2.9 gm., gain 0.2 gm.; MgO in food 0.6 gm., in urine 0.3 gm., in feces 0.3 gm., gain or loss 0; SO_3 in food 4.1 gm., in urine 4.8 gm., in feces 1.0 gm., gain 1.7 gm.; P_2O_5 in food 4.2 gm., in urine 3.1 gm., in feces 2.8 gm., loss 1.7 gm.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1640	1890	Gramatchikov....	Soldier (Ch.)........	....	45.8	70 gm. bread, 131 gm. meat, 1,920 cc. water, 4.8 gm. salt, 46 gm. sugar.	4	......	......	......	......	No fever. KCl in food 1.8 gm., in urine 1.7 gm., in feces 0.2 gm., loss 0.1 gm.; NaCl in food 8.0 gm., in urine 8.5 gm., in feces 0.8 gm., loss 1.3 gm.; CaO in food 0.4 gm., in urine 0.2 gm., in feces 0.2 gm., gain or loss 0; MgO in food 0.5 gm., in urine 0.2 gm., in feces 0.2 gm., gain 0.1 gm.; SO_3 in food 1.4 gm., in urine 1.4 gm., in feces 0.1 gm., loss 0.1 gm.; P_2O_5 in food 3.1 gm., in urine 0.2 gm., in feces 0.9 gm., gain 2.0.
1641	1890	.....do	Soldier (R.).........	....	53.0	190 gm. bread, 2,530 cc. milk, 200 gm. water (7 days).	8	......	......	......	......	Fever. KCl in food 4.9 gm., in urine 3.5 gm., in feces 2.0 gm., loss 0.6 gm.; NaCl in food 3.8 gm., in urine 2.4 gm., in feces 1.7 gm., loss 0.5 gm.; CaO in food 4.1 gm., in urine 0.4 gm., in feces 3.6 gm., loss 0.1 gm.; MgO in food 0.7 gm., in urine 0.1 gm., in feces 0.6 gm., gain or loss 0; SO_3 in food 6.7 gm., in urine 4.3 gm., in feces 2.1 gm., gain 0.3 gm.; P_2O_5 in food 5.1 gm., in urine 2.7 gm., in feces 3.1 gm., loss 0.7 gm.

1642	1890	.....do	.....do	....	50.5	1,005 gm. bread, 1,125 cc. milk, 128 gm. meat, 1,813 cc. water, 4.7 gm. salt.	4	......	......	......	....	No fever. KCl in food 4.0 gm., in urine 2.7 gm., in feces 1.4 gm., loss 0.1 gm.; NaCl in food 11.3 gm., in urine 10.1 gm., in feces 1.9 gm., loss 0.7 gm.; CaO in food 2.2 gm., in urine 0.4 gm., in feces 1.7 gm., gain 0.1 gm.; MgO in food 0.9 gm., in urine 0.3 gm., in foces 0.5 gm., gain 0.1 gm.; SO_3 in food 4.8 gm., in urine 2.3 gm., in feces 0.9 gm., gain 1.6 gm.; P_2O_5 in food 6.1 gm., in urine 2.5 gm., in feces 2.2 gm., gain 1.4 gm.
1643	1890	.....do	Soldier (S.)	....	41.0	1,644 cc. milk, 199 gm. bread, 200 cc. water (5 days).	6	......	......	......	....	Fever. KCl in food 3.1 gm., in urine 3.3 gm., in feces 0.7 gm., loss 0.9 gm.; NaCl in food 2.6 gm., in urino 1.3 gm., in feces 0.7 gm., loss 0.6 gm.; CaO in food 3.1 gm., in urine 0.4 gm., in feces 2.7 gm., gain or loss 0; MgO in food 0.6 gm., in urine 0.3 gm., in feces 0.4 gm., loss 0.1 gm.; SO_3 in food 4.5 gm., in urine 4.0 gm., in feces 1.3 gm., loss 0.8 gm.; P_2O_5 in food 3.8 gm., in urine 3.1 gm., in feces 1.9 gm., loss 1.2 gm.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1644	1890	Gramatchikov	Soldier (S.)	......	42.3	836 gm. bread, 155 gm. meat, 1,750 cc. water, 3.5 gm. salt.	4	......	......	......	......	No fever. KCl in food 2.0 gm., in urine 1.4 gm., in feces 0.5 gm., gain 0.1 gm.; NaCl in food 7.8 gm., in urine 5.3 gm., in feces 1.4 gm., gain 1.1 gm.; CaO in food 0.5 gm., in urine 0.2 gm., in feces 0.2 gm., gain 0.1 gm.; MgO in food 0.6 gm., in urine 0.2 gm., in feces 0.4 gm., gain or loss 0; SO_3 in food 1.7 gm., in urine 1.4 gm., in feces 0.1 gm., gain 0.3 gm.; P_2O_5 in food 3.2 gm., in urine 0.2 gm., in feces 1.2 gm., loss 1.8 gm.
1645	1890	.....do	Soldier (K.)	......	45.0	30 gm. bread, 1,209 cc. milk	6	......	......	......	......	Fever. KCl in food 1.7 gm., in urine 2.6 gm., in feces 0.7 gm., loss 1.6 gm.; NaCl in food 1.4 gm., in urine 1.3 gm., in feces 1.0 gm., loss 0.9 gm.; CaO in food 2.0 gm., in urine 0.2 gm., in feces 1.6 gm., gain 0.2 gm.; MgO in food 0.4 gm., in urine 0.1 gm., in feces 0.3 gm., gain or loss 0; SO_3 in food 2.8 gm., in urine 3.3 gm., in feces 0.5 gm., loss 1.0 gm.; P_2O_5 in food 2.4 gm., in urine 2.5 gm., in feces 1.3 gm., loss 1.4 gm.

1646	1890	Geisler	Man	29	54.0	1,013 cc. milk, 86 gm. bread, 155 gm. Stoke's mixture, 2,375 cc. water.	4	5.1	19.0	1.2	—14.1	Typhus abdominalis.
1647	1890	....do	....do	29	51.1	1,025 cc. milk, 83 gm. bread, 113 gm. Stoke's mixture, 2,063 cc. water.	4	6.0	10.9	1.7	— 6.6	Typhus abdominalis; enemas.
1648	1890	....do	Peasant (R.)	19	45.7	1,023 cc. milk, 115 gm. bread, 154 gm. Stoke's mixture, 300 cc. water.	4	6.6	12.2	1.3	— 6.9	Typhus abdominalis.
1649	1890	....do	....do	19	44.6	1,025 cc. milk, 131 gm. bread, 113 gm. Stoke's mixture, 153 cc. water.	4	6.8	9.5	1.2	— 3.9	Typhus abdominalis; enemas.
1650	1890	....do	Peasant (S.)	21	62.8	555 cc. milk, 47 gm. bread, 116 gm. Stoke's mixture, 638 cc. water.	4	3.1	20.0	1.5	—18.4	Do.
1651	1890	....do	....do	21	60.8	928 cc. milk, 46 gm. bread, 84 gm. Stoke's mixture, 416 cc. water,	4	4.8	15.2	0.8	—11.2	Typhus abdominalis.
1652	1890	....do	Peasant (K.)	15	37.3	700 cc. milk, 30 gm. bread, 113 gm. Stoke's mixture, 385 cc. water.	4	3.7	7.5	2.0	— 5.8	Typhus abdominalis; enemas.
1653	1890	....do	....do	15	36.5	626 cc. milk, 59 gm. bread, 105 gm. Stoke's mixture, 459 cc. water.	4	3.7	8.1	1.3	— 5.7	Typhus abdominalis.
1654	1890	....do	Soldier (O.)	15	53.0	1,000 cc. milk, 64 gm. bread, 120 gm. Stoke's mixture, 1,550 cc. water.	4	5.7	12.0	2.2	— 8.5	Do.
1655	1890	....do	....do	15	50.1	604 cc. milk, 53 gm. bread, 120 gm. Stoke's mixture, 1,345 cc. water.	4	3.7	11.9	1.4	— 9.6	Typhus abdominalis; enemas.
1656	1893	Puritz	Soldier (Ia.)		59.9	Milk, bouillon, bread, wine, cognac	29	8.2	17.1	2.2	—11.1	Do.
1657	1893	....do	Soldier (II.)		58.8	....do	10	7.8	15.1	1.6	— 8.9	Do.
1658	1893	....do	Soldier (Ia.)		49.5	....do	10	12.6	11.7	1.2	— 0.3	Normal health.
1659	1893	....do	Soldier (II.)		53.8	....do	10	16.5	11.8	2.3	+ 2.4	Do.
1660	1893	....do	Soldier (I.)		58.7	Meat, milk, bread, port wine, etc. (180 gm. protein, 60–90 gm. fat, 300 gm. carbohydrates).	12	20.6	24.6	3.7	— 7.7	Typhus adominalis.
1661	1893	....do	Soldier (II.)		55.4	....do	14	22.9	27.7	5.4	—10.2	Do.
1662	1893	....do	Soldier (III.)		53.6	....do	9	23.1	24.5	5.7	— 7.1	Do.
1663	1893	....do	Soldier (IV.)		66.5	....do	17	23.1	24.3	3.6	(—4.8)	Do.
1664	1893	....do	Soldier (V.)		58.8	....do	16	26.0	27.5	4.3	(—5.8)	Do.
1665	1893	....do	Soldier (VI.)		62.5	....do	27	25.0	24.8	4.0	— 3.8	Do.
1666	1893	....do	Soldier (I.)		54.0	....do	10	21.4	15.9	3.4	+ 2.1	After recovery.
1667	1893	....do	Soldier (II.)		52.7	....do	5	26.2	21.6	5.5	— 0.9	Do.
1668	1893	....do	Soldier (III.)		49.3	....do	6	22.6	19.8	4.2	— 1.4	Do.
1669	1893	....do	Soldier (IV.)		66.0	....do	6	28.2	22.7	5.5	— 0.0	Do.
1670	1893	....do	Soldier (V.)		56.6	....do	10	27.6	21.2	4.0	(+2.4)	Do.
1671	1893	....do	Soldier (VI.)		49.8	....do	8	26.5	19.3	6.0	+ 1.2	Do.
1672	1869	Von Boeck	Porter	44		Eggs, milk, bread, butter, beer, etc	5	17.0	14.5	2.0	+ 0.5	No treatment.
1673	1869	....do	....do	44		....do	11	17.6	16.0	2.6	— 1.0	Syphilis. Treatment with mercury.
1674	1869	....do	....do	44				17.4	15.5	2.4	— 0.5	Average of Nos. 1672, 1673.
1675	1869	....do	Student	21		Food same as in No. 1672	7	18.0	15.1	1.3	+ 1.6	No treatment.
1676	1869	....do	....do	21		....do	6	18.3	14.2	2.0	+ 1.1	Syphilis. Treatment with iodid of mercury and iodin.
1677	1869	....do	....do	21				18.0	14.7	2.0	+ 1.3	Average of Nos. 1675, 1676.
1678	1877	Renk	Man	21		Bread, milk, soup, meat, etc	12	11.6	10.2	2.3	— 0.9	Syphilis. For another experiment by Renk see No. 1486.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1679	1892	Yakovlyev	Soldier (Ya.)	24	61	419 gm. bread, 219 gm. meat, 2,294 cc. tea	5	15.3	14.2	0.6	+ 0.5	Syphilis.
1680	1892	do	do	24	60	367 gm. bread, 299 gm. meat, 2,416 cc. tea	5	14.0	15.6	0.7	— 2.3	Do.
1681	1892	do	Soldier (R.)	25	69	814 gm. bread, 267 gm. meat, 669 gm. bouillon, 4,080 cc. tea.	7	22.7	16.3	1.9	+ 4.5	Do.
1682	1892	do	do	25	69	832 gm. bread, 217 gm. meat, 616 gm. bouillon, 3,690 cc. tea.	7	21.7	19.7	2.9	— 0.9	Do.
1683	1892	do	Clerk (P.)	25	64	866 gm. bread, 252 gm. meat, 582 gm. bouillon, 2,200 cc. tea.	7	22.8	14.4	1.4	+ 7.0	Do.
1684	1892	do	do	25	65	854 gm. bread, 192 gm. meat, 566 gm. bouillon, 1,828 cc. tea.	7	20.8	17.7	1.4	+ 1.7	Do.
1685	1892	do	Soldier (Zh.)	23	60	574 gm. bread, 288 gm. meat, 646 gm. bouillon, 2,741 cc. tea.	3	24.0	18.4	2.3	+ 3.3	Do.
1686	1892	do	do	23	59	680 gm. bread, 351 gm. meat, 1,033 gm. bouillon, 3,307 cc. tea.	7	30.1	24.5	3.1	+ 2.5	Do.
1687	1892	do	do	23	60	649 gm. bread, 387 gm. meat, 809 gm. bouillon, 2,923 cc. tea.	7	33.1	27.7	3.0	+ 2.4	Do.
1688	1892	do	do	23	60			31.6	26.1	3.0	+ 2.5	Average of Nos. 1686, 1687.
1689	1892	do	do	23	60	687 gm. bread, 333 gm. meat, 646 gm. bouillon, 2,967 cc. tea.	7	30.7	23.0	1.1	+ 6.6	Syphilis. Treatment with mercury.
1690	1892	do	do	23	60	674 gm. bread, 279 gm. meat, 675 gm. bouillon, 3,232 cc. tea.	7	27.4	20.7	1.6	+ 5.1	Syphilis.
1691	1892	do	Peasant (B.)	36	62	662 gm. bread, 274 gm. meat, 672 gm. bouillon, 2,542 cc. tea.	5	26.2	19.4	2.4	+ 4.4	Do.
1692	1892	do	do	36	62	649 gm. bread, 315 gm. meat, 521 gm. bouillon, 2,480 cc. tea.	7	28.9	21.8	2.6	+ 4.5	Do.
1693	1892	do	do	36	62			27.6	20.6	2.5	+ 4.5	Average of Nos. 1691, 1692.
1694	1892	do	do	36	62	682 gm. bread, 254 gm. meat, 515 gm. bouillon, 2,701 cc. tea.	7	26.1	25.0	1.7	— 0.6	Syphilis. Treatment with mercury.
1695	1892	do	do	36	62	665 gm. bread, 241 gm. meat, 620 gm. bouillon, 2,657 cc. tea.	7	25.3	20.7	1.8	+ 2.8	Syphilis.
1696	1892	do	Soldier (M.)	23	59	554 gm. bread, 332 gm. meat, 459 gm. bouillon, 2,035 cc. tea.	7	23.0	15.7	1.9	+ 5.4	Do.
1697	1892	do	do	23	61	626 gm. bread, 336 gm. meat, 443 gm. bouillon, 2,165 cc. tea.	7	25.4	16.1	4.9	+ 4.4	Syphilis. Treatment with mercury.
1698	1892	do	do	23	61	766 gm. bread, 318 gm. meat, 525 gm. bouillon, 2,507 cc. tea.	7	28.2	15.7	3.2	+ 9.3	Syphilis.

1699	1892	.....do	Medical student (Sh.)	19	57	741 gm. bread, 204 gm. meat, 1,603 cc. tea	5	17.5	12.8	1.5	+ 3.2	Do.
1700	1892	.....do	.....do	19	56	719 gm. bread, 173 gm. meat, 1,755 cc. tea	5	17.8	15.9	1.4	+ 0.5	Syphilis. Subject was given injection of sublimate solution.
1701	1892	.....do	.....do	19	57	713 gm. bread, 150 gm. meat, 1,556 cc. tea	5	17.4	14.8	1.5	+ 1.1	Syphilis.
1702	1893	Troïtsky	Soldier	24	68.9	700.3 gm. meat, 198.7 gm. bread, 47.3 gm. butter, 3,250 gm. water and tea.	3	29.8	21.5	4.9	+ 3.4	Syphilis. Before bath.
1703	1893	.....do	.....do	24	68.9	623.1 gm. meat, 135.9 gm. bread, 34.8 gm. butter, 5,525 gm. water and tea.	3	30.1	17.8	1.5	+10.8	Syphilis. Bath.
1704	1893	.....do	Soldier	31	49	417.9 gm. meat, 108.2 gm. bread, 22.4 gm. butter, 3,333.3 gm. water and tea.	3	18.5	13.3	0.5	+ 4.7	Disease not known. Before bath.
1705	1893	.....do	.....do	31	49	Food same as No. 1704, 3,500 gm. water	2	18.2	7.2	0.5	+10.5	Disease not known. Bath (not full strength). Perspiration contained 0.1 gm. nitrogen not included in balance.
1706	1893	.....do	.....do	31	49	.....do	1	25.4	16.5	0.2	+ 8.7	Disease not known.
1707	1893	.....do	.....do	31	49	.....do	3	22.9	10.9	0.8	+11.2	Disease not known. Bath (natural strength). Perspiration contained 0.2 gm. nitrogen not included in balance.
1708	1893	.....do	.....do	31	49	.....do	1	18.2	16.4	0.9	+ 0.9	Disease not known. After bath. Rest.
1709	1893	.....do	Soldier	28	69	570.4 gm. meat. 201.5 gm. bread, 22.4 gm. butter, 5,000 gm. water.	2	39.3	20.8	2.6	+15.9	Gonorrhea.
1710	1893	.....do	.....do	28	69	544.8 gm. meat, 201.5 gm. bread, 22.4 gm. butter, 5,250 gm. water.	1	38.3	19.6	1.7	+17.0	Gonorrhea. Bath.
1711	1893	.....do	.....do	28	69	615.6 gm. meat, 201.5 gm. bread, 22.4 gm. butter, 5,050 gm. water.	3	27.3	22.4	2.5	+ 2.4	Gonorrhea.
1712	1893	.....do	Soldier	22	76	600 gm. meat, 209.6 gm. bread, 30 gm. butter, 119.4 gm. grits, 46.8 gm. sugar, 679 gm. milk (3 days), 3.533 gm. water and tea.	5	33.3	30.0	2.0	+ 1.3	Syphilis.
1713	1893	.....do	.....do	22	76	600 gm. meat, 210 gm. bread, 30 gm. butter, 119.4 gm. grits, 72 gm. sugar, 679 gm. milk, 4,290 gm. water and tea.	2	35.7	20.2	0.8	+14.7	Syphilis. Bath (not full strength).
1714	1893	.....do	.....do	22	76	600 gm. meat, 210 gm. bread, 30 gm. butter, 119.4 gm. grits, 50 gm. sugar, 679 gm. milk, 3,906 gm. water and tea.	3	35.0	26.1	3.9	+ 5.0	Syphilis. For other experiments by Troïtsky see Nos. 1355-1357. Table 12.
1715	1893	Frolov	Peasant (L.)	25	63	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 cc. milk, 500 cc. bouillon, 1,833 cc. tea, 22 gm. sugar.	3	21.1	18.8	2.9	— 0.6	Syphilis recidiva.
1716	1893	.....do	.....do	25	63	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 483 cc. milk, 500 cc. bouillon, 2,000 cc. tea. 22 gm. sugar.	3	21.0	19.8	2.9	— 1.7	Syphilis recidiva. Treatment with salicylate of mercury.
1717	1893	.....do	.....do	25	62	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 517 cc. milk, 517 cc. bouillon, 2,000 cc. tea, 23 gm. sugar.	3	22.1	21.3	3.1	— 1.3	Do.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1718	1893	Frolov	Peasant (L.)	25	62	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 cc. milk, 500 cc. bouillon, 2,000 cc. tea, 23 gm. sugar.	3	23.3	22.7	3.4	—2.8	Syphilis recidiva. Treatment with salicylate of mercury.
1719	1893	....do	....do	25	63	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 cc. milk, 500 cc. bouillon, 2,000 cc. tea, 21 gm. sugar.	3	22.8	18.4	3.8	+0.6	Syphilis recidiva.
1720	1893	....do	Soldier (P.)	29	59	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 cc. milk, 500 cc. bouillon, 1,300 cc. tea, 20 gm. sugar.	3	21.3	17.8	2.0	+1.5	Do.
1721	1893	....do	....do	29	58	....do	3	21.3	19.4	3.2	—1.3	Syphilis recidiva. Treatment with salicylate of mercury.
1722	1893	....do	....do	29	58	....do	3	21.4	15.6	2.8	+3.0	Do.
1723	1893	....do	....do	29	59	....do	3	21.8	15.6	3.3	+2.9	Syphilis recidiva.
1724	1893	....do	Soldier (T.)	27	73	400 gm. white bread, 600 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 cc. tea, 21 gm. sugar.	3	22.2	19.0	2.4	+0.8	Do.
1725	1893	....do	....do	27	73	....do	3	22.7	17.9	2.4	+2.4	Syphilis recidiva. Treatment with vaseline.
1726	1893	....do	....do	27	72	....do	3	22.6	18.9	2.6	+1.1	Syphilis recidiva. Treatment with salicylate of mercury.
1727	1893	....do	....do	27	72	....do	3	23.6	19.6	1.9	+2.1	Do.
1728	1893	....do	Mechanic (F.)	16	46	200 gm. white bread, 763 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,833 gm. tea, 22 gm. sugar.	3	20.7	15.2	4.5	+1.0	Syphilis recidiva.
1729	1893	....do	....do	16	46	200 gm. white bread, 665 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 23 gm. sugar.	3	19.6	14.8	4.5	+0.3	Syphilis recidiva. Treatment with salicylate of mercury.
1730	1893	....do	....do	16	46	200 gm. white bread, 681 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 22 gm. sugar.	3	20.6	16.9	3.5	+0.2	Do.
1731	1893	....do	....do	16	46	200 gm. white bread, 501 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 23 gm. sugar.	3	19.5	17.1	4.7	—2.3	Do.

1732	1893	.....do	.....do	16	46	200 gm. white bread, 614 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 21 gm. sugar.	3	20.6	15.5	4.3	+0.8	Syphilis recidiva.
1733	1893	.....do	Soldier (Z.)	30	55	400 gm. white bread, 585 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,433 gm. tea, 29 gm. sugar.	3	22.0	17.8	2.1	+2.1	Do.
1734	1893	.....do	.....do	30	56	342 gm. white bread, 600 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,433 gm. tea, 21 gm. sugar.	3	21.6	15.3	3.2	+3.1	Syphilis recidiva. Treatment with salicylate of mercury.
1735	1893	.....do	.....do	30	55	412 gm. white bread, 495 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,200 gm. tea, 21 gm. sugar.	3	22.6	17.4	2.1	+3.1	Do.
1736	1893	.....do	.....do	30	56	400 gm. white bread, 528 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm. tea, 21 gm. sugar.	3	22.9	19.3	2.2	+1.4	Syphilis recidiva.
1737	1893	.....do	Peasant (M.)	18	54	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,833 gm. tea, 22 gm. sugar.	3	21.1	18.0	3.1	0.0	Do.
1738	1893	.....do	.....do	18	54	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 21 gm. sugar.	3	21.1	13.2	4.6	+3.3	Syphilis recidiva. Treatment with salicylate of mercury.
1739	1893	.....do	.....do	18	54	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 22 gm. sugar.	3	22.0	14.5	3.7	+3.8	Do.
1740	1893	.....do	.....do	18	55	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 23 gm. sugar.	3	23.3	13.9	4.1	+6.3	Do.
1741	1893	.....do	.....do	18	54	200 gm. white bread, 800 gm. black bread, 500 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 2,000 gm. tea, 22 gm. sugar.	3	22.8	11.5	5.6	+5.7	Syphilis recidiva.
1742	1893	.....do	Carpenter (M.)	29	58	400 gm. white bread, 600 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,900 gm. tea, 21 gm. sugar.	3	21.1	19.6	2.9	—1.4	Syphilis recens.
1743	1893	.....do	.....do	29	58	.....do	3	21.8	19.6	2.3	—0.1	Syphilis recens. Treatment with salicylate of mercury.
1744	1893	.....do	.....do	29	58	.....do	2	22.2	18.8	1.9	+1.5	Syphilis recens.
1745	1893	.....do	Merchant (Z.)	19	63	400 gm. white bread, 600 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,833 gm. tea, 40 gm. sugar.	3	21.1	20.3	3.6	—2.8	Do.
1746	1893	.....do	.....do	19	64	400 gm. white bread, 482 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,367 gm. tea, 27 gm. sugar.	3	20.7	19.2	2.5	—1.0	Syphilis recens. Treatment with salicylate of mercury.
1747	1893	.....do	.....do	19	64	400 gm. white bread, 473 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,400 gm. tea, 30 gm. sugar.	2	20.9	19.7	1.2	0.0	Syphilis recens.
1748	1893	.....do	Goldsmith (R.)	17	54	200 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm. tea, 20 gm. sugar.	3	15.3	20.0	3.6	—8.3	Do.
1749	1893	.....do	.....do	17	53	233 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm. tea, 20 gm. sugar.	3	21.8	21.4	3.2	—2.8	Syphilis recens. Treatment with salicylate of mercury.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1750	1893	Frolov	Goldsmith (R.)	17	53	300 gm. white bread, 758 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 4,225 gm. tea, 20 gm. sugar.	3	22.5	21.0	4.3	— 2.8	Syphilis recens. Treatment with salicylate of mercury.
1751	1893	...do	...do	17	54	300 gm. white bread, 800 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm. tea, 20 gm. sugar.	3	23.5	19.6	3.0	+ 0.9	Syphilis recens.
1752	1893	...do	Telegraph operator (K.).	23	50	400 gm. white bread, 545 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,833 gm. tea, 74 gm. sugar.	3	20.5	15.3	2.0	+ 3.2	Do.
1753	1893	...do	...do	23	50	357 gm. white bread, 374 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,183 gm. tea, 70 gm. sugar.	3	18.9	15.7	2.5	+ 0.7	Syphilis recens. Treatment with salicylate of mercury.
1754	1893	...do	...do	23	50	400 gm. white bread, 458 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,400 gm. tea, 69 gm. sugar.	2	20.9	15.3	3.4	+ 2.2	Syphilis recens.
1755	1893	...do	Soldier (Gh.)	27	57	400 gm. white bread, 600 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm. tea, 21 gm. sugar.	3	22.2	18.1	1.9	+ 2.2	Do.
1756	1893	...do	...do	27	57	400 gm. white bread, 600 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm. tea, 21 gm. sugar.	3	22.7	17.4	3.5	+ 1.8	Syphilis recens. Treatment with vaselin.
1757	1893	...do	...do	27	57	400 gm. white bread, 600 gm. black bread, 150 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm. tea, 21 gm. sugar.	3	23.2	18.8	3.1	+ 1.3	Do.
1758	1893	...do	...do	27	57	400 gm. white bread, 600 gm. black bread, 145 gm. cutlet, 500 gm. milk, 500 gm. bouillon, 1,300 gm tea, 21 gm. sugar.	3	23.4	18.6	2.8	+ 2.0	Do.
1759	1893	...do	...do	27	57	....	......	23.1	18.3	3.1	+ 1.7	Syphilis recens. Treatment with vaselin.
1760	1886	Kurlov	Factory operative (S.).	32	39.0	847 gm. soup, 589 gm. white bread, 112 gm. meat, 1,433 cc. water, 487 gm. oatmeal.	3	16.8	13.4	3.9	— 0.5	Phthisis.
1761	1886	...do	...do	32	39.2	300 gm. soup (1 day), 67 gm. white bread (9 days), 229 gm. meat, 2,257 cc. milk, 918 cc. water.	11	43.3	29.6	6.4	+ 7.3	Phthisis. Artificial feeding.

1762	1886	do	do	32	40.8	613 gm. soup, 570 gm. white bread, 131 gm. meat, 5 gm. oatmeal, 867 cc. water.	3	17.6	15.1	4.3	— 1.8	Phthisis.
1763	1886	do	Clerk (L.)	21	51.6	1,149 gm. soup, 417 gm. white bread, 113 gm. meat, 3,467 cc. water.	3	14.6	15.6	2.2	— 3.2	Do.
1764	1886	do	do	21	51.8	127 gm. white bread, 250 gm. meat, 3,175 cc. milk, 1,700 cc. water.	3	52.6	35.9	3.9	+12.8	Phthisis. Artificial feeding.
1765	1886	do	do	21	52.4	1,025 gm. soup, 520 gm. white bread, 158 gm. meat, 500 cc. milk, 3,133 cc. water.	3	20.7	21.7	3.2	— 4.2	Phthisis.
1766	1886	do	Clerk (I.)	33	54.9	Fasting	3	0.0	9.3	2.3	—11.6	Do.
1767	1886	do	do	33	56.8	64 gm. white bread, 371 gm. meat powder, 3,517 cc. milk.	6	65.9	31.2	5.3	+29.4	Phthisis. Artificial feeding.
1768	1886	do	do	33	57.3	Fasting	3	0.0	16.1	4.6	—20.7	Phthisis.
1769	1886	do	Painter (Tz.)	26	49.7	do	3	0.0	12.2	2.6	—14.8	Do.
1770	1886	do	do	26	50.0	81 gm. white bread, 301 gm. meat powder, 3,665 cc. milk.	6	54.8	37.9	4.1	+12.8	Phthisis. Artificial feeding.
1771	1886	do	do	26	52.5	Fasting	3	0.0	20.7	2.6	—23.3	Phthisis.
1772	1886	do	do	26	49.5	do	2	0.0	12.5	2.8	—15.3	Do.
1773	1886	do	do	26	51.5	52 gm. white bread, 327 gm. meat powder, 4,277 cc. milk.	6	67.7	39.2	5.8	+22.7	Phthisis. Artificial feeding.
1774	1886	do	do	26	51.8	Fasting	4	0.0	18.2	3.1	—21.3	Phthisis.
1775	1886	do	Factory operative (E.).	23	47.2	do	3	0.0	13.7	2.5	—16.2	Do.
1776	1886	do	do	23	45.9	83 gm. white bread (1 day), 244 gm. meat powder, 2,932 cc. milk (1 day).	9	41.0	29.5	7.3	+ 4.2	Phthisis. Artificial feeding.
1777	1886	do	do	23	45.5	Fasting	3	0.0	17.3	2.4	—19.7	Phthisis.
1778	1887	Bushniev	Man (M.)			Diet not stated	4	26.0	19.9	2.6	+ 3.5	First stage of phthisis.
1779	1887	do	do			do	7	25.6	22.0	2.3	+ 1.3	First stage of phthisis. Subject took creosote.
1780	1887	do	do			do	3	25.8	21.9	2.6	+ 1.3	First stage of phthisis.
1781	1887	do	Man (S.)			do	3	18.9	10.2	5.2	+ 3.5	Second stage of phthisis.
1782	1887	do	do			do	8	16.2	11.4	5.2	— 0.4	Second stage of phthisis. Subject took creosote.
1783	1887	do	do			do	3	15.3	10.4	5.2	— 0.3	Second stage of phthisis.
1784	1887	do	Man (I.)			do	3	21.3	20.4	1.7	+ 0.2	First stage of phthisis.
1785	1887	do	do			do	7	19.8	16.5	1.8	+ 1.5	First stage of phthisis. Subject took creosote.
1786	1887	do	do			do	4	17.8	15.3	3.0	— 0.5	First stage of phthisis.
1787	1887	do	Man (Kh.)			do	6	17.5	18.6	2.2	— 3.3	Second stage of phthisis.
1788	1887	do	do			do	5	17.7	12.5	3.1	+ 2.1	Second stage of phthisis. Subject took creosote.
1789	1887	do	Man (A.)			do	3	20.2	14.2	1.7	+ 4.3	Last stage of phthisis.
1790	1887	do	do			do	4	22.8	12.3	2.1	+ 8.4	Last stage of phthisis. Subject took creosote.
1791	1888	Lipski	Man (T.)	21		1,340 gm. kephir, 121 gm. cutlet, 51 gm. roast meat, 426 gm. bread, 98 gm. manna soup.	2	19.5	13.7	1.9	+ 3.9	Phthisis. No fever. Baths were given and subject took Dovers powder.
1792	1888	do	Man (R.)	60		2,512 gm. kephir, 840 cc. milk	10	18.5	13.0	1.7	+ 3.8	Cancer of œsophagus. Nitrogen in urine was determined for only 9 days.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1793	1888	Lipski	Boy (D.)	18	......	2,265 gm. kephir, —— gm. cutlet	2	19.2	15.1	0.9	+ 3.2	Phthisis.
1794	1888	do	Man (Sh.)	......	......	2,285 gm. kephir	2	14.1	20.4	0.8	— 7.1	Normal health. Nitrogen in urine = amount for 1 day.
1795	1888	Levin	Man (A.)	......	49.5	710 gm. bread, 283 gm. meat, 817 cc. milk	6	23.1	15.1	1.7	+6.3	Phthisis. P_2O_5 in food, 5.7 gm.; in urine, 1.8 gm.; in feces, 1.0 gm.; gain, 2.9 gm.
1796	1888	do	Man (B.)	......	52.5	158 gm. bread, 131 gm. meat, 835 cc. milk	6	11.3	7.2	1.3	+2.8	Phthisis. P_2O_5 in food, 3.3 gm.; in urine, 0.4 gm.; in feces, 2.3 gm.; gain, 0.6 gm.
1797	1888	do	Man (C.)	......	47.8	119 gm. bread, 227 gm. meat, 296 gm. broth, 6 or 7 cups of tea.	6	15.3	16.7	1.7	—3.1	Phthisis. P_2O_5 in food, 1.9 gm.; in urine, 1.8 gm.; in feces, 1.1 gm.; loss, 1.0 gm.
1798	1888	do	Man (D.)	......	32.7	176 gm. bread, 170 gm. meat, 1,500 cc. milk	6	17.8	14.8	2.2	+0.8	Phthisis. P_2O_5 in food, 4.3 gm.; in urine, 2.1 gm.; in feces, 2.4 gm.; loss, 0.2 gm.
1799	1891	Sevastyanov	Soldier (A.)	30	59	431 gm. bread, 358 gm. meat, 375 cc. milk, 51 gm. butter, 2,214 cc. tea and water.	4	21.3	18.8	1.9	+0.6	
1800	1891	do	do	30	59	409 gm. bread, 333 gm. meat, 269 cc. milk, 21 gm. butter, 2,078 cc. tea and water.	4	19.3	20.8	1.3	—2.8	Phthisis. Warm salt baths.
1801	1891	do	do	30	58	441 gm. bread, 373 gm. meat, 363 cc. milk, 24 gm. butter, 2,051 cc. tea and water.	4	21.1	19.4	1.1	+0.6	Phthisis.
1802	1891	do	Factory operative (T.).	33	50	700 gm. bread, 400 gm. meat, 325 cc. milk, 50 gm. butter, 70 gm. rice (1 day), 2,113 cc. tea and water.	4	25.1	17.3	1.8	+6.0	Do.
1803	1891	do	do	33	51	545 gm. bread, 375 gm. meat, 325 cc. milk, 30 gm. butter, 70 gm. rice (1 day), 13 gm. vegetables (2 days), 2,037 cc. tea and water.	4	22.9	18.2	1.1	+3.6	Phthisis. Warm salt baths.
1804	1891	do	do	33	51	500 gm. bread, 300 gm. meat, 313 cc. milk, 30 gm. butter, 1,802 cc. tea and water.	4	19.5	14.8	1.6	+3.1	Phthisis.
1805	1891	do	Factory operative (G.).	26	56	375 gm. bread, 700 gm. meat, 318 cc. milk, 30 gm. butter, 70 gm. rice (1 day), 13 gm. vegetables (2 days), 2,172 cc. tea and water.	4	25.4	20.6	1.0	+3.8	Do.

1806	1891	....do	....do	26	56	254 gm. bread, 538 gm. meat, 375 cc. milk, 30 gm. butter, 1,569 cc. tea and water.	4	19.2	18.1	1.7	—0.6	Phthisis. Warm salt baths.
1807	1891	....do	....do	26	55	178 gm. bread, 399 gm. meat, 450 cc. milk, 30 gm. butter, 1,310 cc. tea and water.	4	13.1	13.9	2.9	—3.7	Phthisis.
1808	1891	....do	Soldier (R.)	30	58	700 gm. bread, 400 gm. meat, 313 cc. milk, 50 gm. butter, 70 gm. rice (1 day), 2,723 cc. tea and water.	4	25.1	20.4	2.4	+2.3	Do.
1809	1891	....do	....do	30	58	650 gm. bread, 375 gm. meat, 300 cc. milk, 30 gm. butter, 60 gm. rice (2 days), 2,624 cc. tea and water.	4	24.6	21.8	1.7	+1.1	Phthisis. Warm salt baths.
1810	1891	....do	....do	30	58	575 gm. bread, 300 gm. meat, 363 cc. milk, 28 gm. butter. 2,642 cc. tea and water.	4	20.9	18.1	1.2	+1.6	Phthisis.
1811	1891	....do	Goldsmith (W.)	44	38	181 gm. bread, 199 gm. meat, 169 cc. milk, 25 gm. butter, 1,308 cc. tea and water.	4	10.5	7.0	1.7	+1.8	Do.
1812	1891	....do	....do	44	37	124 gm. bread, 210 gm. meat, 169 cc. milk, 25 gm. butter, 1,252 cc. tea and water.	4	9.7	8.6	1.0	+0.1	Phthisis. Warm salt baths.
1813	1891	....do	....do	44	36	90 gm. bread. 150 gm. meat, 281 cc. milk, 25 gm. butter, 1,059 cc. tea and water.	4	7.8	6.0	0.5	+1.3	Phthisis.
1814	1891	....do	Soldier (Zh.)	30	55	350 gm. bread, 213 gm. meat, 250 cc. milk, 25 gm. butter, 20 gm. rice (1 day), 2,128 cc. tea and water.	4	13.8	13.1	2.1	—1.4	Do.
1815	1891	....do	....do	30	55	528 gm. bread, 253 gm. meat, 350 cc. milk, 30 gm. butter, 1,795 cc. tea and water.	4	18.4	11.4	1.9	+5.1	Phthisis. Warm salt baths.
1816	1891	....do	....do	30	55	560 gm. bread, 300 gm. meat. 400 cc. milk, 30 gm. butter, 1,688 cc. tea and water.	4	18.2	16.7	3.8	—2.3	Phthisis.
1817	1892	Laudenheimer	Man	23	......	900 cc. modified milk, egg, soup, meat, bread, etc.	4	14.4	12.0	2.0	+0.4	Phthisis incipiens (?). NaCl in food, 18.5 gm.; in urine, 16.6 gm.; in feces, 0.3 gm.; gain, 1.6 gm.
1818	1892	....do	....do	23	......	1,800 gm. modified egg, soup, meat, bread, etc.	4	24.4	16.9	(2.0)	+5.5	Phthisis incipiens (?). Nitrogen in urine = average of two days. NaCl in food, 18.5 gm.; in urine, 18.6 gm.; in feces, 0.3 gm.; loss, 0.4 gm.
1819	1893	Bochkarev	Peasant (P.)	20	47	400 gm. bread, 200 gm. meat, 35 gm. butter, 470 cc. milk, 50 gm. sugar, 2,588 cc. water or tea.	4	13.9	14.7	1.3	—2.1	Phthisis.
1820	1893	....do	....do	20	48	400 gm. bread, 200 gm. meat, 35 gm. butter, 590 cc. milk, 50 gm. sugar, 2,870 cc. water or tea.	4	16.2	13.9	1.1	+1.2	Phthisis. Subject took 50 gm. malt extract.
1821	1893	....do	....do	20	47	400 gm. bread, 200 gm. meat, 35 gm. butter, 480 cc. milk, 50 gm. sugar, 2,110 cc. water or tea.	4	15.4	13.6	1.4	+0.4	Phthisis.
1822	1893	....do	Servant (G.)	40	56	500 gm. bread, 200 gm. meat, 35 gm. butter, 470 cc. milk, 50 gm. sugar, 2,923 cc. water or tea.	4	15.4	14.5	1.9	—1.0	Do.
1823	1893	....do	....do	40	56	500 gm. bread, 200 gm. meat, 35 gm. butter, 590 cc. milk, 50 gm. sugar, 2,930 cc. water or tea.	4	18.2	13.4	2.0	+2.8	Phthisis. Subject took 94 gm. malt extract.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1824	1893	Bochkarev	Servant (G.)	40	57	500 gm. bread, 200 gm. meat, 35 gm. butter, 480 cc. milk, 50 gm. sugar, 2,530 cc. water or tea.	4	17.3	13.3	2.3	+1.7	Phthisis.
1825	1893	do	Peasant (E.)	20	54	434 gm. bread, 220 gm. meat, 41 gm. butter, 435 cc. milk, 70 gm. sugar, 2,789 cc. water or tea.	4	18.0	18.6	3.5	—4.1	Do.
1826	1893	do	do	20	54	418 gm. bread, 220 gm. meat, 39 gm. butter, 413 cc. milk, 70 gm. sugar, 3,069 cc. water or tea.	4	19.5	18.6	2.5	—1.6	Phthisis. Subject took 94 gm. malt extract.
1827	1893	do	do	20	55	496 gm. bread, 215 gm. meat, 35 gm. butter, 413 cc. milk, 70 gm. sugar, 3,049 cc. water or tea.	4	20.2	17.7	2.0	+0.5	Phthisis.
1828	1893	do	Peasant (D.)	23	56	600 gm. bread, 220 gm. meat, 60 gm. butter, 380 cc. milk, 70 gm. sugar, 3,265 cc. water or tea.	4	21.0	15.8	1.5	+3.7	Do.
1829	1893	do	do	23	56	558 gm. bread, 220 gm. meat, 56 gm. butter, 413 cc. milk, 70 gm. sugar, 3,489 cc. water or tea.	4	22.6	18.5	1.5	+0.6	Phthisis. Subject took 100 gm. malt extract.
1830	1893	do	do	23	55	513 gm. bread, 215 gm. meat, 47 gm. butter, 495 cc. milk, 70 gm. sugar, 2,909 cc. water or tea.	4	20.8	16.4	1.5	+2.9	Phthisis.
1831	1893	do	Soldier (Th.)	24	51	500 gm. bread, 220 gm. meat, 60 gm. butter, 440 cc. milk, 50 gm. sugar, 3,065 cc. water or tea.	4	20.0	18.4	2.8	—1.2	Do.
1832	1893	do	do	24	50	608 gm. bread, 220 gm. meat, 60 gm. butter, 440 cc. milk, 50 gm. sugar, 2,526 cc. water or tea.	4	21.4	16.4	2.8	+2.2	Phthisis. Subject took 100 gm. malt extract.
1833	1893	do	do	24	50	600 gm. bread, 220 gm. meat. 60 gm. butter, 440 cc. milk, 50 gm. sugar, 2,929 cc. water or tea.	4	21.0	17.4	2.6	+1.0	Phthisis.
1834	1893	do	Blacksmith (Th.)	28	66	578 gm. bread, 220 gm. meat, 60 gm. butter, 440 cc. milk, 51 gm. sugar. 3.105 cc. water or tea.	4	21.6	19.2	2.9	—0.5	Do.
1835	1893	do	do	28	65	559 gm. bread, 220 gm. meat, 64 gm. butter, 440 cc. milk, 50 gm. sugar, 4,269 cc. water or tea.	4	20.5	19.7	2.4	—1.6	Phthisis. Subject took 100 gm. malt extract.

1836	1893	.....do	.....do	28	64	506 gm. bread, 220 gm. meat, 60 gm. butter, 440 cc. milk, 50 gm. sugar, 3,259 cc. water or tea.	4	19.2	19.1	2.5	—2.4	Phthisis.
1837	1893	.....do	Peasant (R.)	20	44	261 gm. bread, 220 gm. meat, 10 gm. butter, 435 cc. milk, 26 gm. sugar, 1,720 cc. water or tea.	4	14.9	13.8	3.4	—2.3	Do.
1838	1893	.....do	.....do	20	44	213 gm. bread, 220 gm. meat, 21 gm. butter, 385 cc. milk, 29 gm. sugar, 1,550 cc. water or tea.	4	15.0	14.2	3.3	—2.5	Phthisis. Subject took 81 gm. malt extract.
1839	1893	.....do	.....do	20	43	88 gm. bread (1 day), 100 gm. meat (1 day), 330 cc. milk, 25 gm. sugar, 1,800 cc. water or tea.	2	4.7	9.2	1.8	—6.3	Phthisis.
1840	1894	Blumenfeld (Spirig).	Woman	29	......	360 gm. white bread, 153 gm. meat, 89 gm. egg, 800 gm. soup, 1,000 gm. coffee, 100 gm. butter, 2,077 gm. water (108.9 gm. fat, 256 gm. carbohydrates, 2,359 calories).	3	11.6	11.0	1.6	—1.0	Phthisis. Butter period.
1841	1894	.....do	.....do	17	......	200 gm. meat, 85 gm. egg, 30 gm. sugar, 297 gm. white bread, 800 gm. coffee, 400 gm. soup, 80 gm. butter, 400 gm. water (84.2 gm. fat, 208.4 gm. carbohydrates, 1,980 calories).	3	13.4	10.8	0.9	+1.7	Do.
1842	1894	.....do	.....do	17	......	200 gm. meat, 303 gm. white bread, 66 gm. lipanin, 83 gm. egg, 30 gm. sugar, 400 gm. soup, 800 gm. coffee, 400 gm. water (85.7 gm. fat, 211.8 gm. carbohydrates, 1,894 calories).	3	13.1	9.6	1.3	+2.2	Phthisis. Lipanin period.
1843	1894	.....do	.....do	17	......	200 gm. meat, 315 gm. white bread, 80 gm. butter, 85 gm. egg, 30 gm. sugar, 400 gm. soup, 800 gm. coffee, 400 gm. water (84.2 gm. fat, 218.8 gm. carbohydrates, 2,827 calories).	3	13.6	10.8	1.1	+1.7	Phthisis. Butter period.
1844	1894	.....do	.....do	42	......	200 gm. meat, 314 gm. white bread, 80 gm. butter, 83 gm. egg, 1,000 gm. milk, 30 gm. sugar, 400 gm. soup, 800 gm. coffee, 400 gm. mineral water (120.2 gm. fat, 263.4 gm. carbohydrates, 2,677 calories).	5	18.9	16.3	1.0	+1.6	Do.
1845	1894	.....do	.....do	42	......	200 gm. meat, 316 gm. white bread, 45 gm. butter, 84 gm. egg, 57 gm. lipanin (3 days), 1,000 gm. milk, 30 gm. sugar, 400 gm. soup, 400 gm. mineral water (116.3 gm. fat, 264.6 gm. carbohydrates, 2,657 calories).	6	19.1	17.3	1.2	+0.6	Phthisis. Butter-lipanin period.
1846	1894	.....do	.....do	42	......	200 gm. meat, 315 gm. bread, 80 gm. butter, 82 gm. egg, 1,000 gm. milk, 30 gm. sugar, 400 gm. soup, 800 gm. coffee, 400 gm. mineral water (118.9 gm. fat, 264 gm. carbohydrates, 2,641 calories).	3	19.1	16.7	0.7	+1.7	Phthisis. Butter period.
1847	1894	.....do	.....do	42	......	200 gm. meat, 320 gm. white bread, 80 gm. butter. 85 gm. egg, 50 gm. lipanin, 1,000 gm. milk, 30 gm. sugar, 400 gm. soup, 800 gm. coffee, 400 gm. mineral water (167.8 gm. fat, 267.3 gm. carbohydrates, 3,129 calories).	3	19.2	16.4	1.2	+1.6	Phthisis. Butter-lipanin period.

TABLE 17.—*Experiments with subjects with specific infectious diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1848	1891	Pipping	Girl (L.)	6¼	17.6	Mixed diet, 734 gm. water (34.7 gm. protein, 15.1 gm. fat, 102.7 gm. carbohydrates).	13	5.6	6.4	0.5	—1.3	Diphtheria. Abnormally high temperature.
1849	1891	...do	Boy (A.)	4½	17.5	Mixed diet, 1,507 gm. water (45.6 gm. protein, 16.9 gm. fat, 203.3 gm. carbohydrates).	14	7.3	6.0	0.6	+0.7	Do.
1850	1891	...do	...do	4⅓	17.3	Mixed diet, 1,272 gm. water (43.3 gm. protein, 16.5 gm. fat, 143.5 gm. carbohydrates).	4	6.9	6.1	0.5	+0.3	Convalescence.
1851	1891	...do	Girl (H.)	11½	21.9	Mixed diet, 890 gm. water (14.2 gm. protein, 5.3 gm. fat, 68.4 gm. carbohydrates).	8	2.3	5.7	0.3	—3.7	Diphtheria. Abnormally high temperature.
1852	1891	...do	...do	11½	21.7	Mixed diet, 1,356 gm. water (52.1 gm. protein, 8.4 gm. fat, 266.1 gm. carbohydrates).	3	8.3	5.7	0.9	+1.7	Convalescence.
1853	1891	...do	Boy (A.)	10	19.8	Mixed diet, 1,246 gm. water (24.7 gm. protein, 3.3 gm. fat. 138.8 gm. carbohydrates).	6	4.0	5.9	0.6	—2.5	Diphtheria. Abnormally high temperature.
1854	1891	...do	...do	10	19.8	Mixed diet, 1,485 gm. water (76.4 gm. protein, 13.9 gm. fat, 317.1 gm. carbohydrates).	3	12.2	6.3	2.1	+3.8	Convalescence.
1855	1891	...do	Boy (S.)	10¼	29.4	Mixed diet, 1,579 gm. water (55.5 gm. protein, 11.3 gm. fat, 148.8 gm. carbohydrates).	6	8.9	11.1	0.9	—3.1	Diphtheria. Abnormally high temperature.
1856	1891	...do	Girl (B.)	4⅓	14.9	Mixed diet, 944 gm. water (29.8 gm. protein, 6.4 gm. fat, 113 gm. carbohydrates).	7	4.8	3.8	0.9	+0.1	Do.
1857	1891	...do	...do	4⅓	15.3	Mixed diet, 1,662 gm. water (56.1 gm. protein, 9.3 gm. fat, 237 gm. carbohydrates).	2	9.0	7.3	0.8	+0.9	Convalescence.

No. 1486. Untersuchung der Kost, p. 116. No. 1487. Ztschr. klin. Med., 1, p. 535. Nos. 1488, 1489. Virchow's Arch., 89, pp. 106, 320. No. 1490. Ibid., p. 117. No. 1491. Ibid., p. 112. No. 1492. Ibid., p. 110. No. 1493. Ibid., p. 107. No. 1494. Ibid., p. 109. No. 1495. Ibid., p. 105. No. 1496. Ibid., p. 120. No. 1497. Ibid., p. 117. No. 1498. Ibid., p. 116. No. 1499. Ibid., p. 111. No. 1500. Ibid., p. 113. No. 1501. Ibid., p. 114. No. 1502. Ibid., p. 111. No. 1503. Ibid., p. 114. No. 1504. Ibid., p. 108. No. 1505. Ibid., p. 115. No. 1506. Ibid., p. 109. Nos. 1507–1512. The influence of fever and antipyretics on the metabolism and assimilation of the protein of milk. Inaug. Diss. (Russian), St. Petersburg, 1883, p. 44. Nos. 1513–1518. Ibid., p. 46. Nos. 1519–1524. Ibid, p. 48. Nos. 1525–1530. Ibid., p. 50. Nos. 1531–1535. Ibid., p. 52. Nos. 1536–1541. Ibid., p. 54. Nos. 1542–1546. Ibid., p. 56. Nos. 1547, 1548. The qualitative and quantitative metabolism of nitrogen of typhoid patients and the assimilation of protein. Inaug. Diss. (Russian), St. Petersburg, 1886, Table 1. Nos. 1549, 1550. Ibid., Table 2. Nos. 1551, 1552. Ibid., Table 3. Nos. 1553, 1554. Ibid., Table 4. Nos. 1555, 1556. Ibid., Table 5. No. 1557. Ibid., Table 6. Nos. 1558, 1559. Ibid., Table 7. Nos. 1560, 1561. Ibid., Table 8. Nos. 1562, 1563. Ibid., Table 9. No. 1564. Ztschr. klin. Med., 16, p. 542. Nos. 1565, 1566. Influence of alcohol upon assimilation and metabolism of nitrogen in typhoid fever. Inaug. Diss. (Russian), St. Petersburg, 1890, p. 54, Table 1. Nos. 1567–1569. Ibid., p. 56, Table 2. Nos. 1570–1572. Ibid., p. 58, Table 3. Nos. 1573–1575. Ibid., p. 60, Table 4. Nos. 1576–1578. Ibid., p. 62, Table 5. Nos. 1579–1581. Ibid., p. 64, Table 6. Nos. 1582, 1583. Ibid., p. 66, Table 7. Nos. 1584–1587. Influence of copious water drinking on the assimilation and metabolism of nitrogen in typhoid fever. Inaug. Diss. (Russian), St. Petersburg, 1890, Table 1. Nos. 1588–1593. Ibid., Table 2. Nos. 1594–1598. Ibid., Table 3. Nos. 1599–1602. Ibid., Table 4. Nos. 1603–1606. Ibid., Table 5. Nos. 1607–1609. Ibid., Table 6. Nos. 1610–1613. Ibid., Table 7. Nos. 1614–1617. Ibid., Table 8. Nos. 1618, 1619. Vrach, 11, p. 213, Table 1. Nos. 1620, 1621. Ibid., Table 2. Nos. 1622, 1623. Ibid., p. 214, Table 3. Nos. 1624, 1625. Ibid., Table 4. Nos.

1626, 1627. Ibid., p. 258, Table 5. Nos. 1628, 1629. Ibid., Table 6. Nos. 1630, 1631. Ibid., Table 7. Nos. 1632, 1633. Ibid., Table 8. Nos. 1634–1636. The influence of fever upon the metabolism of mineral matter. Inaug. Diss. (Russian), St. Petersburg, 1890, Table 1. Nos. 1637, 1638. Ibid., Table 2. Nos. 1639, 1640. Ibid., Table 3. Nos. 1641, 1642. Ibid., Table 4. Nos. 1643, 1644. Ibid., Table 5. No. 1645. Ibid., Table 6. Nos. 1646, 1647. Vrach, 11, p. 479, Table 1. Nos. 1648, 1649. Ibid., Table 2. No. 1650. Ibid., Table 3. No. 1651. Ibid., p. 480, Table 3. Nos. 1652, 1653. Ibid., Table 4. Nos. 1654, 1655. Ibid., Table 5. Nos. 1656, 1657. Virchow's Arch., 131, p. 343. Nos. 1658, 1659. Ibid., p. 344. Nos. 1660–1665. Ibid., p. 350. Nos. 1666–1671. Ibid., p. 351. Nos. 1672–1674. Ztschr. Biol., 5, p. 400. Nos. 1675–1677. Ibid., p. 405. No. 1678. Untersuchung der Kost, p. 111. Nos. 1679, 1680. The metabolism of nitrogen in syphilitic subjects. Inaug. Diss. (Russian), St. Petersburg, 1892, p. 48. Nos. 1681–1684. Ibid., p. 50. Nos. 1685–1690. Ibid., p. 52. Nos. 1691–1695. Ibid., p. 54. Nos. 1696–1698. Ibid., p. 56. Nos. 1699–1701. Ibid., p. 58. Nos. 1702–1708. Prag. Med. Wochenschr., 18, p. 393. Nos. 1709–1714. Ibid., p. 405. Nos. 1715–1719. Influence of salicylate of mercury on the metabolism and assimilation of nitrogen in subjects with syphilis. Inaug. Diss. (Russian), St. Petersburg, 1893, p. 72. Nos. 1720–1723. Ibid., p. 74. Nos. 1724–1727. Ibid., p. 76. Nos. 1728–1732. Ibid., p. 78. Nos. 1733–1736. Ibid., p. 80. Nos. 1737–1741. Ibid., p. 82. Nos. 1742–1744. Ibid., p. 84. Nos. 1745–1747. Ibid., p. 86. Nos. 1748–1751. Ibid., p. 88. Nos. 1752–1754. Ibid., p. 90. Nos. 1755–1759. Ibid., p. 92. Nos. 1760–1762. Assimilation and metabolism of protein in feeding phthisical patients by De Bove's method. Inaug. Diss. (Russian), 1886, Table 1. Nos. 1763–1765. Ibid., Table 2. Nos. 1766–1768. Ibid., Table 3. Nos. 1769–1771. Ibid., Table 4. Nos. 1772–1774. Ibid., Table 5. Nos. 1775–1777. Ibid., Table 6. Nos. 1778–1780. Vrach, 8, p. 1004. Nos. 1781–1790. Ibid., p. 1005. No. 1791. Ibid., 9, p. 645. Nos. 1792–1794. Ibid., p. 684. Nos. 1795, 1796. Ibid., p. 878. Nos. 1797, 1798. Ibid., p. 879. Nos. 1799–1801. The influence of salt baths on the metabolism and assimilation of nitrogen in phthisis patients. Inaug. Diss. (Russian), St. Petersburg, 1891, pp. 48, 49. Nos. 1802–1804. Ibid., pp. 50, 51. Nos. 1805–1807. Ibid., pp. 52, 53. Nos. 1808–1810. Ibid., pp. 54, 55. Nos. 1811–1813. Ibid., pp. 56, 57. Nos. 1814–1816. Ibid., pp. 58, 59. Nos. 1817, 1818. Ztschr. klin. Med., 21, p. 542. Nos. 1819–1821. The influence of malt extract on the metabolism and assimilation of nitrogen in phthisis patients. Inaug. Diss. (Russian), St. Petersburg, 1893, p. 2. Nos. 1822–1824. Ibid., p. 4. Nos. 1825–1827. Ibid., p. 6. Nos. 1828–1830. Ibid., p. 8. Nos. 1831–1833. Ibid., p. 10. Nos. 1834–1836. Ibid., p. 12. Nos. 1837–1839. Ibid., p. 14. No. 1840. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 3, p. 108. Nos. 1841, 1842. Ibid., p. 112. No. 1843. Ibid., p. 113. No. 1844. Ibid., p. 114. No. 1845. Ibid., p. 115. No. 1846. Ibid., p. 116. No. 1847. Ibid., p. 117. No. 1848. Skand. Arch. Physiol., 2, p. 101. Nos. 1849, 1850. Ibid., p. 103. Nos. 1851, 1852. Ibid., p. 104. Nos. 1853–1855. Ibid., p. 105. Nos. 1856, 1857. Ibid., p. 107.

No. 1486. See No. 1678.

No. 1487. This experiment and Nos. 1858, Table 18, and 2039 and 2040, Table 20, were made by Röhmann at the Medical Institute of the University of Berlin in 1877–78. The object was to investigate the excretion of chlorids during fever, that is, when the body temperature was higher than normal. The subject of No. 1487 was suffering from typhoid fever. The food consisted of meat, eggs, milk, etc. The sodium chlorid was determined in the urine and feces and in all the food except the meat; that was calculated, using Voit's value.

In addition to this test and those noted beyond the author studied the excretion of sodium chlorid by a man in normal health. He himself was the subject. The test covered 8 days. The daily diet consisted of bread, unsalted fat, meat, and 5 grams of salt. Beer and water were consumed as beverages. On an average 9.5 grams of sodium chlorid were excreted daily in the urine and 0.05 gram in the feces.

A test with a female dog weighing about 31 kilograms is recorded. For a number of days (until in nitrogen equilibrium) the subject consumed daily 100 grams of ship biscuit, 100 grams of unsalted fat, 70 grams of condensed milk, 500 cubic centimeters of water, and 2 grams of salt. The test proper lasted 7 days. In addition to the above diet, on 3 days the dog consumed daily 750 grams of meat. This quantity of meat contained 0.9 gram of sodium chlorid. On an average the dog excreted daily in the urine 2.7 grams of nitrogen.

From these experiments and those in the tables beyond the conclusion was reached by the author that in acute fever the chlorids consumed are not excreted in normal quantity in the urine.

Nos. 1488–1506 were made by Hoesslin in one of the Munich hospitals in 1877–78. At this time Rubner was making his investigations on the digestibility of various articles of food by healthy men, and it seemed to the investigator, who was an assistant in the hospital, that similar investigations should be made with individuals who were ill. The subjects were suffering from typhoid fever.

The food was very carefully prepared, and every precaution was taken in the collection of the excreta. The food was analyzed in many cases. In some cases—for instance, white of egg, yolk of egg, and milk—the composition was estimated from König's figures or some other reliable source. The feces were analyzed and the urea in the urine was determined. No particular method of separating the feces was employed. In most cases the experiments with the same individual were continuous, and the various articles of food were such that the feces could be separated with considerable accuracy. The diet is expressed in terms of protein, fat, and carbohydrates.

In many of the experiments the subjects had more or less diarrhea. It was found that even when the diarrhea was severe the dry matter excreted was not materially increased. It was found that when the fever was moderate (38–40.5° C.) and the diarrhea also moderate the digestion and assimilation of protein, fat, and carbohydrates were not much different from that of healthy individuals.

The questions whether protein, fat, or carbohydrates is best for a diet in fever, and the influence of the consumption of food on high temperature in fever and its duration, are discussed at length.

Nos. 1507–1546 were made by Zasietski in St. Petersburg in 1881–82 (?) to study the influence of fever and antipyretics on the metabolism and assimilation of the protein of milk. Fifteen experiments are described. Fourteen subjects were patients with typhoid fever and one with simple recurrent fever. The treatment for reducing the temperature consisted in 9 cases of cold baths, in 4 cases of quinin hydrochlorate, and in 2 cases of sodium salicylate. The cold baths had a temperature of 22.5° C. in most cases and lasted 15 minutes. The subject sat in the bath up to his neck, and water was poured on the head. This treatment was followed for 2 or 3 days, after which there was a period of 2 or 3 days without treatment. During the whole time the food consisted exclusively of milk and water. There were two periods during the fever and a period of 2 or 3 days 16 to 35 days after the cessation of the fever. The nitrogen of the milk and feces was determined by the Will-

Warrentrapp method, and of the urine by the Seegen method. The phosphates were also determined in the urine. The uranium and sodium acetate method was followed.

The author summarizes his results as follows:

The metabolism of nitrogen and the excretion of phosphates in the urine decreased under the influence of cold baths and in the majority of cases, though in a less degree, under the influence of quinin and sodium salicylate.

Quinin and sodium salicylate increased the quantity of urine in the majority of cases and cold baths in all cases. Cold baths, quinin and sodium salicylate, also improved the assimilation of the solids and the nitrogen of milk in all cases.

Antipyretics decreased the consumption of water in the majority of cases. Under the influence of cold baths the loss of water through the skin and lungs usually decreased.

During fever the assimilation of the solids and the nitrogen of the milk was not so good as when there was no fever.

These experiments were also published by the author in German,[1] his name being transliterated Sassetzky.

Nos. 1547–1563 were made by Khadgi in St. Petersburg in 1888. The object was to study the metabolism and assimilation of nitrogen by typhoid-fever patients in its qualitative and quantitative relations. Eight experiments are described, each divided into two periods, (1) during the time of fever, and (2) during convalescence. The duration of the periods varied in different cases. In No. 1557 the convalescent period was omitted. The food consisted of milk and bread with or without meat and broth. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method, the urea by the Borodin method, and the uric acid by the Haycraft method.

The author arrives at the following conclusions: In all cases the absolute quantity of nitrogen in the urine was less in the first period than in the second. The quantitative metabolism of nitrogen in the first period, judging from the ratio of the nitrogen excreted in the urine to that assimilated, was higher than in the second period. In nearly every case the metabolism of the first period was inferior in quality to that of the second, indicating that the nitrogenous decomposition products undergo more complete oxidation during convalescence than during fever. In the majority of cases the assimilation was better in the second period than in the first. On an average it may be represented in the second period by 87.5 per cent and in the first by 83.8 per cent.

The author published the results of a number of these experiments in German.[2] His name was transliterated Chadchi.

No. 1564. See Nos. 2219–2226, Table 24.

Nos. 1565–1583 were made by Diakonov in St. Petersburg in 1890. The object was to investigate the influence of alcohol on the metabolism and assimilation of nitrogen in subjects with typhoid fever. Seven experiments were made with subjects suffering from typhoid fever in some form. Five of the experiments were divided into three periods of 4 days each. During the second period alcohol was taken with the food. Two experiments consisted of only two periods, one with and one without alcohol. Some of the subjects had never before used alcohol, while others had used it occasionally. The food consisted of bread and milk. Each subject consumed during the alcohol period the equivalent of 50 cubic centimeters absolute alcohol. It was diluted to 40° Tralles.

The following conclusions were reached: The temporary use of alcohol lowered the assimilation of protein by the typhoid subjects, the effect being greatest in the subjects not used to taking alcohol. It also lessened the appetite and increased the quantity of feces. The relative and absolute quantities of protein broken down in the organism were decreased. When the assimilation of nitrogen was slightly diminished the metabolism of nitrogen was also diminished. When the former was

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[1] Virchow's Archiv., 94, p. 533. [2] Virchow's Archiv., 131, p. 344.

considerably diminished the latter was increased. During the alcohol period the qualitative metabolism of nitrogen was inferior to that of the other periods, i. e., the quantity of incompletely oxidized decomposition products in the urine was increased, the quantity of urine was increased, and the absolute and relative cleavage of protein was decreased. The general condition of the subjects was improved.

Nos. 1584–1617 were made by Matzkevich in St. Petersburg in 1890. The object was to investigate the influence of copious drinking of water on the assimilation and metabolism of nitrogen in typhoid patients. Eight series of experiments are described. They were from 16 to 20 days' duration, divided into from three to six periods. The subjects were suffering from ileo-typhus. The treatment followed was that adapted to the symptoms and was not modified for experimental purposes. During the fever the subjects received two or three baths a day, and in two cases were given tincture strophanthus. A mixed diet was consumed, which included Stoke's mixture.[1] Large quantities of water (2,000 to 3,000 cubic centimeters) were consumed daily in one or more periods. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The author sums up his results as follows: The assimilation of protein increased under the influence of copious drinking of water. The increase was most marked at the time of high temperature (in the second period). During convalesence, however, the assimilation of protein decreased. The metabolism of nitrogen in three cases was least during the period of copious drinking and greatest in the following period. In general, however, an increase of the metabolism was observed. The subjects decreased in weight. This decrease was more or less uniform, the organism apparently tending to maintain its weight. Copious water drinking does not seem to have any influence on the temperature, pulse, or respiration. Under the influence of copious drinking the amount of urine increased and its specific gravity diminished. The occurrence of diarrhea does not not preclude copious drinking of water.

Nos. 1618–1633 were made by Gruzdiev in St. Petersburg in 1890. The object was a comparison of the influence of copious and moderate water drinking on the metabolism and assimilation of nitrogen, on the blood pressure, and on excretions of the skin and lungs in patients with acute fever. Eight metabolism experiments are described. Each experiment lasted 10 days and was divided into 2 equal periods, one of copious and one of moderate water drinking. In 5 cases the period of moderate drinking preceded that of copious drinking; in 3 cases the order was reversed. The maximum amount of water drunk during the period of moderate drinking was 13,869 grams and the minimum 5,725 grams; the maximum during the period of copious drinking was 18,001 grams and the minimum 10,835 grams. The food consisted of bread and milk. In several cases meat was eaten also. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method and the nitrogen of the urea by the Borodin method.

The author briefly sums up the results of his experiments as follows: Copious drinking of hot or cold water in febrile diseases intensified the metabolism of nitrogen and improved it qualitatively. It improved the assimilation of the nitrogen and increased the arterial tension and the excretions of the skin and lungs.

In the opinion of the author it is advisable to permit fever patients to drink as much water as they desire. If, for any reason, the patient does not ask for water the physician should in one way or another enforce copious drinking, within reasonable bounds.

Nos. 1634–1645 were made by Gramatchikov in St. Petersburg in 1890. The chief object was the study of the metabolism of the mineral constituents of the organism under the influence of fever. Six experiments are described; in 2 of these the metabolism of nitrogen was also observed. The food consisted of bread and milk, and in some cases meat also.

[1] Aqua cinnamoni simplicis, vinum cognacium, vitellum ovi, tinctura valerianæ, sirup simplex.

The nitrogen in food, urine, and feces was determined by the Kjeldahl-Borodin method. The mineral salts and sulphuric and phosphoric acids were also determined.

The author draws the following conclusions: During the fever in all subjects an increased excretion of potassium salts was observed; the metabolism of sodium salts was increased, but in less degree; the amount of calcium and magnesium salts in the organism appeared to vary very little; the metabolism of nitrogen, sulphuric and phosphoric acids increased, and the assimilation of nitrogen decreased.

Nos. 1646–1655 were made by Geisler in St. Petersburg in 1890, to study the influence of hot enemas on the metabolism and assimilation of nitrogen in subjects with typhus abdominalis.

Five experiments are described, consisting of two periods of 4 days each. During one period the patient was given daily an enema of 1 liter of water of 42–43° C. The food consisted of milk and bread. During both periods the subjects took tepid baths of 35° C., and were given Stoke's mixture. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The urea of the urine was estimated by Borodin's method.

The author sums up his results as follows: Under the influence of hot enemas the assimilation of nitrogen was decreased, the metabolism of nitrogen was increased, and the quantity of extractives in the urine was also slightly increased.

Nos. 1656–1671 were made by Puritz in St. Petersburg in 1890–1892 in Professor Tschudnovski's laboratory. The object was to study the effect of abundant diet in typhus abdominalis. As the investigator points out, Graves, in the years 1840–1850, was the first to urge the necessity of a rational diet in fevers. Investigators since that time have not agreed as to the amount and kind of food, i. e., protein, fat, or carbohydrates, necessary in such cases, though the opinion is almost universal that considerable nourishment is required. The subjects were soldiers and were all suffering from typhus abdominalis, though several experiments (Nos. 1666–1671) were made after the fever had ceased. Few details of these are recorded.

Two sorts of diet suggested themselves to the author as "abundant:" (1) A diet which contained protein enough to cover the entire nitrogen excretion, which is increased in acute fever, and about the same amount of fat and carbohydrates as would be required by a healthy individual of the same weight as the subject; and (2) a diet which contained large quantities of carbohydrates and fat and a normal quantity of protein. In these experiments a diet of the first type was selected. It consisted of meat, bread, milk, Stoke's mixture, tea, coffee, port wine, etc. The diet contained about 180 grams of protein, 60 to 90 grams of fat, and about 300 grams of carbohydrates. The food and drink were given often, but in small quantities. The patients were also given two or three baths per day, but no drugs were prescribed. The nitrogen in the food, urine, and feces was determined.[1]

For the sake of comparison, in experiments Nos. 1656–1659, the subjects received insufficient nutriment. Their diet contained on an average 40 grams of protein, 10 to 20 grams of fat, and 100 to 150 grams of carbohydrates.

In the experiments during fever 79 to 82 per cent of the nitrogen consumed was assimilated, and after the fever ceased 85.6 to 90.5 per cent. During fever the nitrogen in the urine was much greater than the amount consumed. The conclusion is reached that fever increases metabolism.

The following conclusions were also drawn:

When large quantities of liquid are consumed patients with typhus abdominalis can digest very considerable quantities of protein, both during the fever and the first days after it has ceased.

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[1]In Nos. 1663, 1664, and 1670 the figures given by the author for loss of nitrogen could not be obtained from his published figures for consumed and excreted nitrogen. There is probably an error in the printing or the statement of the data. The figures in parentheses were computed by the compilers.

During fever protein digestion is not quite so complete when the diet is abundant as it is when the diet is insufficient. The different periods of the disease have very little effect upon assimilation. When the diet is abundant and rich in protein the amount of urea in the urine increases. With abundant diet the amount of nitrogen metabolized decreases, although the intensity of the metabolism increases. With abundant nourishment the daily loss of weight and of nitrogen is slightly diminished. With an abundance of food and water the quantity of urine is increased. These conditions, however, have no effect on the production of albumen in the urine. Abundant nourishment causes no rise in temperature.

Neither complications, relapse, nor lengthening of the fever period was observed when the diet was abundant.

The patients were more comfortable and the organs performed their functions better with an abundant diet, and convalescence was shorter.

The article also contains many references to previous work.

Nos. 1672–1677 were made by von Boeck in Munich in 1868. The object of these experiments was to investigate the effect of mercury and iodids on metabolism in subjects with syphilis. The subjects were a porter and a student. They were suffering from syphilis in the primary stage and were inmates of the city hospital. The porter was robust, but the student seemed poorly nourished and had been in poor health for some time before his present illness. The diet followed in these experiments was very simple, consisting of eggs, bread, butter, milk, meat extract, and beer. The food was prepared by von Boeck, and food, urine, and feces were analyzed. In Nos. 1672–1674 the subject was treated with mercury in the form of gray ointment and protiodid pills. In Nos. 1675–1677 the subject was treated with a 10 per cent solution of hydriodic acid (=1.49 grams of iodin per day).

The conclusion is reached that in these experiments the drugs used exercised no influence on the metabolism of nitrogen.

No. 1678. This experiment and No. 1486 were made by Renk in 1877 (?), and form part of an extended investigation of the dietaries of the inmates of a hospital in Munich. The subject in No. 1678 was suffering from syphilis; in No. 1486 the subject was recovering from an attack of typhus abdominalis. In each case the food was a mixed diet consisting of soup, bread, meat, etc. The nitrogen in the urine was determined, and that in the food was calculated. From the results of other investigations the nitrogen in the feces was supplied by the compilers. In both cases the diet was hardly sufficient for the needs of the individual.

No conclusions concerning the income and outgo of nitrogen were drawn by the author.

Nos. 1679–1701 were made by Yakovlyev in St. Petersburg in 1892. The object was to study the metabolism and assimilation of nitrogen in subjects with syphilis. Seven experiments were made. In three of the experiments, Nos. 1679–1684, the subjects received no special medical treatment. These experiments were divided into two periods, the first before the appearance of the roseolæ and the second after its appearance.

In Nos. 1685–1698 the subjects were treated with unguentum hydrargyri duplex, and in Nos. 1699–1701 the subject was given subcutaneous injections of corrosive-sublimate solution.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: The quantitative metabolism of nitrogen increases during the first eruptive stage of syphilis, while the qualitative metabolism decreases. The assimilation of nitrogen also decreases. Under the influence of treatment with mercury the assimilation of nitrogen usually improves, while the metabolism of nitrogen is lowered.

Nos. 1702–1714. See Nos. 1355–1357, Table 12.

Nos. 1715–1759 were made by Frolov in St. Petersburg in 1893. The object was to study the influence of treatment with mercury upon the metabolism and assimilation

of nitrogen in subjects with syphilis recidiva and in those with the disease in earlier stages. Eleven experiments were made, of from 8 to 15 days' duration. They were divided into periods of 3 or 3 and 2 days. On the first day of one or more periods the subjects were given an injection of salicylate of mercury suspended in liquid vaselin. In several instances injections of vaselin alone were given.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: Injections of salicylate of mercury increased the qualitative metabolism of nitrogen in subjects with syphilis recidiva, although the assimilation of nitrogen was sometimes lowered. If, however, the metabolism of nitrogen was very intense and the assimilation bad, as is the case in the first stages of the disease, injections of salicylate of mercury lowered the metabolism of nitrogen somewhat, while the assimilation was improved and the quantity of incompletely oxidized products excreted in the urine was diminished. When the disease was left to run its course without treatment, reverse changes in the metabolism of nitrogen were observed both in the early and later stages.

Nos. 1760–1777 were made by Kurlov in St. Petersburg in 1886. The object was to investigate the metabolism and assimilation of protein in phthisical subjects fed by De Bove's method. The experiments were made with 5 subjects with phthisis. The experiments lasted 9 to 17 days, and each was divided into three periods. In the first and third periods the dietary conditions were normal or the subjects fasted. In the second period the subjects underwent De Bove's forced feeding treatment. In most cases a meat powder (prepared in Kariev's laboratory) mixed with milk was fed by means of a stomach tube, though in a few cases the subjects drank the mixture. The nitrogen in the urine and feces was determined in all cases, and the nitrogen of the food in some cases. The Kjeldahl-Borodin method was used.

Owing to relapse one subject (Nos. 1769–1774) was treated twice.

The following conclusions were reached: Under the influence of forced feeding the metabolism and assimilation of nitrogen improved, the subjects gained rapidly in weight, the appetite improved, the temperature was lowered, and in most cases diarrhea was relieved. The general condition improved, the shortness of breath was relieved, perspiration and coughing and expectoration decreased, and sleep improved.

Nos. 1778–1790 were made by Bushuiev in St. Petersburg in 1887. In an extended investigation on the influence of creosote in the treatment of phthisis, the author studied the metabolism of nitrogen and its qualitative and quantitative relations; that is, he determined the ratio between urea and the partially oxidized nitrogenous constituents of urine, including uric acid and extractives.

Five experiments are described—2 with subjects in the first stage of phthisis, 2 with subjects in the second stage, and 1 with a subject in the last stage. Each experiment was divided into three periods—a creosote period of 7 to 8 days preceded and followed by a period of 3 or 4 days without creosote. The dose of creosote in all cases was 2 or 3 drops administered in the form of pills. The food consumed is not stated. The inference is that it was a mixed diet. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

Among the conclusions reached were the following: The qualitative metabolism of nitrogen by the subjects was strikingly lower than that of healthy persons, and in treatment with creosote it was lowered still more. The assimilation of nitrogen deteriorated markedly under the influence of creosote, while the metabolism of nitrogen did not appear to be altered quantitatively. The daily losses in weight were less under the influence of creosote than when no creosote was taken.

Nos. 1778–1780 were not taken into consideration in the conclusions, as the subject had an almost normal temperature and exhibited only slight local symptoms.

Nos. 1791–1794 were made by Lipski in St. Petersburg in 1888. The object was to study the assimilation of kephir. Two of the subjects had phthisis, one had cancer of the œsophagus, and one was a healthy person. The nitrogen of the food,

urine, and feces was determined by the Kjeldahl method and the fat was determined by the Sohxlet method. The subjects usually received 6 or 7 glasses of kephir a day with other food.

The author drew the following conclusions: The nitrogenous and the fatty constituents of kephir were assimilated by both healthy and diseased subjects, as well as those of milk, and therefore the use of kephir as a remedy which improves nutrition deserves consideration. Patients, especially consumptives, often take kephir more willingly than milk.

Nos. 1795–1798 were made by Levin in St. Petersburg in 1888. The object was to study the metabolism of nitrogen and phosphorus in subjects with phthisis. In the opinion of the author, simultaneous determinations of the total metabolism of phosphorus and nitrogen are necessary for a knowledge of their mutual relations in consumptive patients.

Four experiments are described, each lasting 6 days. The food consisted of bread, meat, and milk. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The phosphates of the food and feces were determined by the Sonnenschein method and of the urine by titrating with uranium acetate.

The following conclusions were reached: In No. 1795, where the intestinal functions were normal, the metabolism of nitrogen was as low as 73.46 per cent. The metabolism of phosphorus was considerably lower, namely, 37.28 per cent. This is a marked case of parallelism between the metabolism of phosphorus and that of nitrogen. In No. 1796 similar relations are observed. The extremely low figures for the phosphates in the urine are very noticeable. This was doubtless due to the very poor health of the subject, who died shortly after the close of the experiment. In this case the low percentage of metabolism was not due to impaired digestion, but to the inability to oxidize the food.

In No. 1797 the subject had fever all the time, ate little, and continually lost weight. The metabolism of nitrogen was 122.81 per cent and the metabolism of phosphates 223.63 per cent. The assimilation of the latter was only 43.10 per cent. This is a case of real phosphaturia.

The subject of No. 1798 had diarrhea. The metabolism of nitrogen was 93.86 per cent and of phosphoric acid 112.38 per cent. More phosphates were excreted in the feces than in the urine, a condition never observed in the metabolism of nitrogen.

Nos. 1799–1816 were made by Sevastyanov in St. Petersburg in 1891. The object was to study the metabolism and assimilation of nitrogen in phthisis patients under the influence of salt baths. Six experiments are described. In four experiments the subjects were in the last stages of phthisis, and in two they had symptoms of incipient phthisis. Each experiment was divided in three periods of 4 days each, and in the second period salt baths were taken. The baths were prepared by adding sufficient salt to warm water (35° C.) to make a 1 per cent solution. The subjects remained in the bath for 30 minutes. They dried themselves lightly, without rinsing off the salt water.

The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following conclusions were reached: The assimilation of nitrogen increased during the bath period, and in some cases the increase was noticed during the period after the baths. The metabolism of nitrogen increased quantitatively during and after the bath period, but in both periods it decreased qualitatively. The subjects lost weight in most cases during the second and third periods. Under the influence of the baths the subjects slept better.

Nos. 1817, 1818. See Nos. 1964–1971, Table 19.

Nos. 1819–1839 were made by Bochkarev at the University of St. Petersburg in 1892 and 1893. The object was to study the influence of malt extract on the metabolism and assimilation of nitrogen in phthisis patients. Seven experiments are described. The subject of the seventh experiment (Nos. 1837–1839) was in the last stage of consumption, while the others were not so far advanced. Each experiment was divided

into three periods of 4 days each. Malt extract in milk was given in the second period. The food consisted of a mixed diet. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The malt extract exerted no influence upon the subject of the seventh experiment. From the other experiments the following conclusions are drawn: Malt extract somewhat improved the appetite, and the thirst was slightly increased. The assimilation of nitrogen was increased a little and the metabolism very slightly lowered. The ratio of incompletely oxidized products excreted in the urine to urea was increased; that is, the process of oxidation was diminished. The ratio of neutral sulphur in the urine to acid sulphur was decreased. This indicated a decrease in the breaking down of nitrogenous tissue. The subjects gained in weight.

Nos. 1840–1847 were reported by Blumenfeld. They were made by him or by Spirig at the Charité Hospital in Berlin in 1893–94. The object was to investigate the assimilation of fat. The subjects were 3 women—hospital patients suffering from consumption. The food consisted of milk, coffee, soup, white bread, etc., and butter or lipanin, a preparation of olive oil and oleic acid, which is said to be assimilated more easily than cod-liver oil. In some cases both butter and lipanin were consumed. The nitrogen and fat in the food and the carbohydrates in the bread were determined, and also the nitrogen in the urine and the nitrogen and fat in the feces. A number of additional experiments were made by Spirig in which the urine was not analyzed.

The assimilation of lipanin was found to be normal, but it was not more thoroughly utilized than butter, although it contains a larger percentage of fat. Lipanin is not a more digestible fat than butter. It is useful for consumptive patients when it is not possible to give the desired amount of fat in the food in other forms.

Nos. 1848–1857 were made by Pipping at the laboratory of the Carolinian Medical-Surgical Institute in Stockholm in 1890. The object was to determine the influence of fever, i. e., a temperature higher than normal, upon the metabolism of children. The subjects were children suffering from diphtheria (?). The food consisted of bread eggs, milk, sago soup, and similar articles. The nitrogen in the urine and feces and the phosphoric acid in the urine were determined. It is not stated whether the composition of the food was determined or calculated. In several cases the metabolism of the subject was studied some days after the fever period had ceased, when the patient was convalescent.

The following conclusions were reached: During the fever period the nitrogen excretion is usually very much increased in proportion to the amount consumed. Sometimes, however, it remains normal when the patient is well nourished. When there is moderate fever, nitrogenous food does not produce increased excretion of nitrogen; on the other hand, it is possible by this means to make up for the breaking down of protein. When the fever is moderate the assimilation of protein is about as good as in health. The excretion of phosphorus is diminished during fever.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM CONSTITUTIONAL DISEASES.

In Table 18 are included 87 experiments with men, 9 with women, and 1 with a child, in which the subjects were suffering from rheumatism, gout, diabetes, or scurvy. In some of the experiments the effect of drugs, in others the effect of a special diet, was tested. These and other special questions are noted in the text accompanying the table. Some of the experiments with diabetic subjects have been made to study the general laws of nutrition. All the experiments with diabetic subjects in which the balance of income and outgo of carbon was determined in addition to nitrogen will be found in Table 26.

TABLE 18.—*Experiments with subjects with constitutional diseases.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1858	1879	Röhmann	Man (D.)	31	......	Milk, coffee, bread	14	......	......	......	......	Rheumatism. NaCl in food, 7.4 gm.; in urine, 8.0 gm.; in feces, 0.0 gm.; loss, 0.6 gm.
1859	1893	Vogel	Man	40	......	Mixed diet	5	14.9	11.8	1.9	+1.2	Gout. Subject was given saturatio citrica.
1860	1893	...do	...do	40	......		6	16.4	11.1	1.8	+3.5	Gout. Subject was given pipirizin.
1861	1893	...do	...do	40	......	Mixed diet	13	14.1	12.8	1.5	—0.2	Gout.
1862	1893	...do	Man	53	......	...do	5	13.3	7.9	2.1	+3.3	Gout. Subject was given saturatio citrica.
1863	1893	...do	...do	53	......	...do	5	15.5	8.0	2.3	+5.2	Gout. Subject was given 5 gm. pipirizin.
1864	1893	...do	...do	53	......	...do	7	12.9	8.1	1.2	+3.6	Gout.
1865	1893	...do	...do	53	......	...do	7	13.8	11.0	1.6	+1.2	Gout. Subject was given 2 gm. pipirizin.
1866	1893	...do	...do	53	......	...do	2	14.4	11.7	1.1	+1.6	Last two days of No. 1865.
1867	1893	...do	Man	37	......	...do	5	11.0	4.6	1.2	+5.2	Gout.
1868	1893	...do	...do	37	......	...do	6	12.4	6.1	1.0	+5.3	Do.
1869	1893	...do	...do	37	......	...do	10	16.9	13.6	1.7	+1.6	Gout. See also Nos. 818, 819, Table 10.
1870	1866	Gaehtgens	Observer	23	55	1,160 gm. milk, 30 gm. butter, 320 gm. white bread, 153.5 gm. rye bread, 640.1 cc. soup, 374.1 gm. meat, a little coffee, tea, sugar, and cream, 822.8 cc. water.	15	34.6	24.8	2.1	+7.7	Normal health. Ash in food, 29.7 gm.; in urine, 24.8 gm.; in feces, 4.0 gm.; gain, 0.9 gm.
1871	1866	...do	Man	31	49	Food, same as No. 1869, with 906.8 cc. water.	15	34.6	31.9	4.8	—2.1	Diabetes. Ash in food, 29.7 gm.; in urine, 31.0 gm.; in feces, 9.4 gm.; loss, 10.7 gm.
1872	1866	...do	Observer	23	......	51.6 gm. sugar, 89.2 cc. cream, 261.8 gm. white bread, 52.6 gm. rye bread, 142.2 gm. bolted rye bread, 525.6 cc. soup, 349.3 gm. meat, 31.4 gm. butter. 263.2 cc. tea, 297.1 cc. coffee, 513.1 cc. water.	19	26.5	17.9	2.4	+6.2	Normal health. Subject was given 7.8 gm. sodium bicarbonate; ash in food, 20.5 gm.; in urine, 18.1 gm.: in feces, 4.7 gm.; loss, 2.3 gm.

1873	1866	.....do	Man	31	....	24.7 gm. sugar, 96.7 cc. cream, 298.7 gm. white bread, 63.2 gm. rye bread, 68.4 gm. bolted rye bread, 589.6 cc. soup, 391.3 gm. meat, 35.5 gm. butter, 346.6 cc. tea, 314.5 cc. coffee, 553.3 cc. water.	19	29.9	25.5	2.6	+1.8	Diabetes. Subject given 7.8 gm. sodium bicarbonate; ash in food, 23.2 gm.: in urine, 24.2 gm.; in feces, 5.1 gm.; loss, 6.1 gm.
1874	1866	.....do	Observer	23	....	60 gm. sugar, 97.6 cc. cream, 45 gm. butter, 295 gm. white bread, 100 gm. rye bread. 80 gm. bolted rye bread, 486.4 cc. soup, 526.4 gm. meat, 332 cc. coffee, 331 cc. tea, 527.2 cc. water.	5	36.8	27.3	2.6	+6.9	Normal health. Subject was given 8.1 gm. sodium benzoate; ash in food, 23.6 gm.; in urine 21.0 gm.; in feces, 5.0 gm.; loss, 2.4 gm.
1875	1866	.....do	Man	31	....	20 gm. sugar, 97.6 cc. cream, 45 gm. butter, 295 gm. white bread, 100 gm. rye bread, 80 gm. bolted rye bread, 486.4 cc. soup, 526.4 gm. meat, 232 cc. coffee, 331cc. tea, 527.2 cc. water.	5	36.8	29.4	4.1	+3.3	Diabetes. Subject was given 8.1 gm. sodium benzoate; ash in food, 23.6 gm.; in urine, 30.7 gm.; in feces, 8.0 gm.; loss, 15.1 gm.
1876	1888	Levin	Merchant	60	79.5	192 gm. meat, 537 gm. bread, 139 gm. cheese, 550 gm, bouillon, 74 gm. butter, 1,625 cc. tea, 250 cc. water (4 days).	5	22.2	20.2	1.5	+0.5	Intermittent diabetes. P_2O_5 in food, 6.2 gm.; in urine, 3.4 gm.; in feces, 1.2 gm.; loss, 1.6 gm.
1877	1888	.....do	.....do	60	79.6	262 gm. meat, 427 gm. bread, 106 gm. cheese, 650 gm. bouillon, 89 gm. butter, 1,825 cc. tea, 250 cc. water (2 days).	5	23.6	20.7	1.1	+1.8	Intermittent diabetes. Tepid baths; P_2O_5 in food, 4.7 gm.; in urine, 3.4 gm.; in feces, 1.2 gm.; loss, 0.1 gm.
1878	1890	Jawein	Copyist (D.)	35	41.1	1,459 gm. bread, 1,786 cc. milk, 259 gm. meat..	7	41.9	37.2	4.6	+0.1	Diabetes.
1879	1890	.....do	.....do	35	43.6	1,612 gm. bread. 1,260 cc. milk, 308 gm. meat..	5	45.4	38.3	4.6	+2.5	Diabetes. Subject was given 10 gm. sodium bicarbonate.
1880	1890	.....do	.....do	35	42.0	1,010 gm. bread, 1,300 cc. milk, 672 gm. meat, 75 gm. butter.	4	37.1	40.2	5.7	—8.8	Diabetes.
1881	1890	.....do	.....do	35	41.1	1,599 gm. bread, 1,050 cc. milk, 300 gm. meat..	5	45.5	41.5	4.0	0.0	Diabetes. Abundant protein diet.
1882	1890	.....do	Man (V.)	25	35.2	298 gm. bread, 1,314 cc. milk, 196 gm. meat...	6	17.9	24.4	1.6	—8.1	Diabetes.
1883	1892	Fritz Voit	Man	....	54.5	430 gm. meat, 200 cc. milk, 200 gm. bacon, 60 gm. butter, 300 cc. wine.	3	16.5	16.2	0.8	—0.5	
1884	1892	.....do	.....do	....	....	450 gm. meat, 200 cc. milk, 250 gm. bacon, 60 gm. butter, 300 cc. wine.	3	15.8	15.2	0.9	—0.3	Do.
1885	1892	.....do	.....do	....	54.0	450 gm. meat, 200 cc. milk, 250 gm. bacon, 60 gm. butter, 300cc. wine, 164 gm. milk sugar.	1	15.8	14.9	0.0	+0.9	Do.
1886	1892	.....do	Man	....	54.0	430 gm. meat, 200 cc. milk, 250 gm. bacon. 60 gm. butter, 300 cc. wine.	3	17.7	15.2	0.8	+1.7	Normal health.
1887	1893	Leo	Woman	54	....	150 gm. meat, 1,000 cc. milk, 30 gm. white bread, 500 cc. coffee, 4 eggs.	5	19.0	18.0	1.5	—0.5	Diabetes.
1888	1893	.....do	.....do	54	....	150 gm. meat, 1,000 cc. milk, 30 gm. white bread, 500 cc. coffee, 4 eggs, 95 gm. maizena, 50 gm. sugar, 250 cc. water.	1	19.0	18.7	0.9	—0.6	Do.
1889	1893	.....do	.....do	54	....	150 gm. meat, 1,000 cc. milk, 30 gm. white bread, 373 cc. coffee, 4 eggs, 375 cc. water.	2	19.0	18.9	1.1	—1.0	Do.

TABLE 18.—*Experiments with subjects with constitutional diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1890	1893	Leo	Woman	54	......	150 gm. meat, 1,000 cc. milk, 30 gm. white bread, 500 cc. coffee, 4 eggs, 115 gm. maizena, 40 gm. sugar, 800 cc. water.	1	19.0	20.2	1.0	—2.2	Diabetes.
1891	1893	....do	....do	54	......	150 gm. meat, 1,000 cc. milk, 30 gm. white bread, 250 cc. coffee (1 day), 4 eggs.	2	19.0	20.7	1.1	—2.8	Do.
1892	1893	....do	Man	36	......	300 gm. meat (boiled or roasted), 260 gm. black bread, 50 gm. butter, 80 cc. cognac, 100 gm. salad, 250 cc. bouillon, 500 cc. coffee, 4 eggs.	6	25.7	23.3	1.7	+0.7	Do.
1893	1893	....do	....do	36	......	300 gm. meat (boiled or roasted), 260 gm. black bread, 50 gm. butter, 80 cc. cognac, 100 gm. salad, 250 cc. bouillon, 500 cc. coffee, 30 gm. maizena, 18 gm. sugar, 100 cc. water.	2	25.7	22.1	2.9	+0.7	Do.
1894	1893	....do	....do	36	......	Same as No. 1892	1	25.7	23.0	1.8	+0.9	Do.
1895	1893	....do	....do	36	......	300 gm. meat (boiled or roasted), 260 gm. black bread, 50 gm. butter, 80 cc. cognac, 100 gm. salad, 250 cc. bouillon, 500 cc. coffee, 4 eggs, 50 gm. maizena, 23.5 gm. sugar, 130 cc. water.	1	25.7	23.5	1.8	+0.4	Do.
1896	1893	....do	....do	36	......	Same as No. 1892	1	25.7	21.3	0.9	+3.5	Do.
1897	1893	Burchard and Finkelstein.	Observer (F.)	......	65	100 gm. smoked salmon, 250 gm. beef, 70 gm. bacon, 6 eggs, 50 gm. cheese, 80 gm. butter, 1,500 cc. water.	5	23.0	23.3	0.5	—0.8	Normal health. Diet without carbohydrates.
1898	1893	....do	Observer (B.)	......	49	100 gm. smoked salmon, 250 gm. beef, 15 gm. bacon, 6 eggs, 50 gm. cheese. 80 gm. butter, 1,500 cc. water.	5	23.2	23.4	1.1	—1.3	Do.
1899	1893	....do	Man (K.)	35	55	100 gm. smoked salmon, 250 gm. beef, 35 gm. bacon, 6 eggs, 50 gm. cheese, 80 gm. butter, 1,500 cc. water.	5	23.1	22.1	0.9	+0.1	Diabetes. Diet without carbohydrates.
1900	1893	....do	Observer (F.)	......	......	Same as No. 1897, with 75.0 gm. dextrose	1	22.6	21.4	0.5	+0.7	Normal health. Diet with carbohydrates.
1901	1893	....do	....do	......	......	Same as No. 1897, with 50 gm. dextrose	4	22.9	20.5	0.5	+1.9	Do.
1902	1893	....do	....do	......	......	Same as No. 1897, with 100 gm. dextrose	2	22.9	19.9	0.5	+2.5	Do.
1903	1893	....do	Observer (B.)	......	......	Same as No. 1897, with 75 gm. dextrose	1	22.7	20.6	0.7	+1.4	Do.
1904	1893	....do	....do	......	......	Same as No. 1897, with 50 gm. dextrose	4	22.9	20.0	0.7	+2.2	Do.
1905	1893	....do	....do	......	......	Same as No. 1897, with 100 gm. dextrose	1	23.0	17.5	0.7	+4.8	Do.
1906	1893	....do	Man (K.)	35	......	Same as No. 1897, with 75 gm. dextrose	1	22.7	18.4	1.0	+3.3	Diabetes. Diet with carbohydrates.

1907	1893	.....do	.....do	35	....	Same as No. 1897, with 50 gm. dextrose	6	23.0	19.2	1.0	+2.8	Do.
1908	1893	.....do	.....do	35	....	Same as No. 1897, with 100 gm. dextrose	1	23.1	21.4	1.0	+0.7	Do.
1909	1893	.....do	.....do	35	....	Same as No. 1897	4	22.2	20.2	1.0	+1.0	Diabetes. Diet without carbohydrates.
1910	1893	.....do	.....do	35	....	Same as No. 1897, with 100 gm. levulose	3	23.1	20.6	1.1	+1.4	Diabetes. Diet with carbohydrates.
1911	1893	.....do	.....do	35	....	Same as No. 1897, with 100 gm. milk sugar	4	23.1	20.8	1.0	+1.3	Do.
1912	1893	.....do	.....do	35	....	Same as No. 1897, with 100 gm. dextrose	4	23.1	20.1	1.0	+2.0	Do.
1913	1893	Strauss	Tailor	26	64	350 gm. meat, 56 gm. bacon, 150 gm. butter, 120 gm. salad, 120 gm. sauerkraut, 40 gm. whisky, 28 gm. oil.	1	16.5	10.3	1.0	+5.2	Diabetes.
1914	1893	....do	.....do	26	....	350 gm. meat, 100 gm. bacon, 150 gm. butter, 120 gm. salad, 120 gm. sauerkraut, 40 gm. whisky, 28 gm. oil.	33	16.4	12.4	0.9	+3.1	Do.
1915	1895	Pautz	Physician	24	....	500 gm. meat, 99 gm. bread, 200 gm. butter, etc. (222.3 gm. fat, 60.8 gm. carbohydrates, 79.5 gm. alcohol).	8	27.3	23.2	1.5	+2.6	Normal health. Energy in food, 3,572 calories; in urine, 0 calories; in feces, 105 calories; gain, 3,467 calories.
1916	1895	.....do	.....do	24	....	600 gm. meat, 99 gm. bread, 200 gm. butter, 456 gm. egg, etc. (224.3 gm. fat, 60.8 gm. carbohydrates, 79.5 gm. alcohol).	5	30.9	29.5	1.3	+0.1	Normal health. Energy in food, 3,683 calories; in urine, 0 calories; in feces, 95 calories; gain, 3,588 calories.
1917	1895	.....do	Real estate agent	54	....	600 gm. meat, 99 gm. bread, 200 gm. butter, 456 gm. egg, etc. (224.3 gm. fat, 60.8 gm. carbohydrates, 79.5 gm. alcohol).	5	30.9	26.9	1.2	+2.8	Normal health. Energy in food, 3,683 calories; in urine, 0 calories; in feces, 133 calories; gain, 3,550 calories.
1918	1895	.....do	Boy	15	....	250 gm. meat, 99 gm. bread, 100 gm. butter, 282 gm. egg, etc. (117.4 gm. fat, 60.3 gm. carbohydrates, 31.8 gm. alcohol).	5	15.6	15.3	1.0	—0.7	Normal health. Energy in food, 1,960 calories; in urine, 0 calories: in feces, 62 calories; gain, 1,898 calories.
1919	1895	.....do	Merchant	48	....	500 gm. meat, 200 gm. potato, eggs, vegetables, etc. (208.4 gm. fat, 42.4 gm. carbohydrates, 61.5 gm. alcohol).	1	25.6	22.2	2.6	+0.8	Diabetes. Energy in food, 3,338 calories; in urine, 71 calories; in feces, 88 calories; gain, 3,179 calories.
1920	1895	.....do	Woman	51	....	250 gm. meat, 60 gm. gray bread, 150 gm. butter, 289.4 gm. egg, etc. (156.5 gm. fat, 31.9 gm. carbohydrates, 24.6 gm. alcohol).	3	17.3	16.1	1.0	+0.2	Diabetes. Energy in food, 2,201 calories; in urine, 179 calories; in feces, 88 calories; gain, 1,934 calories.
1921	1895	.....do	Real estate agent	62	....	400 gm. meat, 99 gm. bread (1 day), 200 gm. butter, 337.7 gm. egg, etc. (202.5 gm. fat, 16.3 gm. carbohydrates, 48.6 gm. alcohol).	4	21.7	18.2	1.5	+2.0	Diabetes. Energy in food, 3,165 calories; in urine, 23 calories; in feces, 85 calories; gain, 3,057 calories.

TABLE 18.—*Experiments with subjects with constitutional diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1922	1895	Pautz	Woman	28	......	371 gm. beef, 245 gm. veal, 80 gm. bread, 150 gm. butter, 240 gm. egg, etc. (151.9 gm. fat, 48.9 gm. carbohydrates, 48.9 gm. alcohol).	2	26.2	20.4	1.1	+4.7	Diabetes. Energy in food, 2,714 calories; in urine, 285 calories; in feces, 54 calories; gain, 2,375 calories.
1923	1895	.....do	Merchant	46	......	250 gm. meat, 100 gm. bread, 150 gm. butter, etc. (136.3 gm. fat, 61.1 gm. carbohydrates, 91.9 gm. alcohol).	2	13.3	12.0	1.6	—0.3	Diabetes. Energy in food, 2,502 calories; in urine, 23 calories; in feces, 106 calories; gain, 2,373 calories.
1924	1895	.....do	Tinsmith	38	......	375 gm. beef, 250 gm. veal, 180 gm. bread, 150 gm. butter, 144.7 gm. egg, etc. (155.4 gm. fat, 108.0 gm. carbohydrates).	2	26.1	21.3	1.4	+3.4	Diabetes. Energy in food, 2,557 calories; in urine, 0 calories; in feces, 121 calories; gain, 2,436 calories.
1925	1895	.....do	Farmer	58	......	200 gm. beef, 200 gm. veal, 110 gm. butter, 96.5 gm. egg, etc. (103.7 gm. fat, 0.9 gm. carbohydrates, 61.5 gm. alcohol).	2	14.9	18.6	1.4	—5.1	Diabetes. Energy in food, 1,780 calories; in urine, 27 calories; in feces, 69 calories; gain, 1,684 calories.
1926	1895	.....do	Merchant	50	......	200 gm. beef, 200 gm. veal, 140 gm. butter, 385.9 gm. egg, 60 gm. bread, etc. (160.3 gm. fat, 37.4 gm. carbohydrates, 92.3 gm. alcohol).	2	22.2	22.4	2.7	—2.9	Diabetes. Energy in food, 2,858 calories; in urine, 334 calories; in feces, 144 calories; gain, 2,380 calories.
1927	1895	.....do	Merchant	47	......	300 gm. beef, 200 gm. veal, 30 gm. gray bread, 170 gm. butter, 289.4 gm. egg, etc. (184.9 gm. fat, 43.1 gm. carbohydrates, 158.8 gm. alcohol).	2	25.5	27.3	2.9	—4.7	Diabetes. Energy in food, 3,106 calories; in urine, 233 calories; in feces, 153 calories; gain, 2,720 calories.
1928	1895	.....do	Boy	12	......	200 gm. beef, 200 gm. veal, 60 gm. bread, 150 gm. butter, 355 gm. egg, etc. (160.4 gm. fat, 36.0 gm. carbohydrates).	3	20.6	20.2	1.7	—1.3	Diabetes. Energy in food, 2,167 calories; in urine, 153 calories; in feces, 96 calories; gain, 1,918 calories.

1929	1895	.....do	Merchant	37	....	300 gm. beef, 200 gm. veal, 96 gm. bread, 180 gm. butter, 436 gm. egg, etc. (193.9 gm. fat, 60.0 gm. carbohydrates).	5	28.2	22.5	2.3	+3.4	Diabetes. Energy in food, 2,771 calories; in urine, 0 calories; in feces, 139 calories; gain, 2,632 calories.
1930	1895	.....do	Manufacturer	53	....	300 gm. beef, 200 gm. veal, 99 gm. bread, 180 gm. butter, 273 gm. egg, etc. (178.2 gm. fat, 60.0 gm. carbohydrates).	5	25.0	20.1	1.8	+3.1	Diabetes. Energy in food, 2,544 calories; in urine, 12 calories; in feces, 101 calories; gain, 2,431 calories.
1931	1895	.....do	Cigar maker	45	....	300 gm. beef, 200 gm. veal, 99 gm. bread, 180 gm. butter, 275.4 gm. egg, etc. (178.5 gm. fat, 60.0 gm. carbohydrates).	5	25.1	18.9	2.5	+3.7	Diabetes. Energy in food, 2,548 calories; in urine, 264 calories; in feces, 147 calories; gain, 2,137 calories.
1932	1895	.....do	Woman	67	....	150 gm. beef, 150 gm. veal, 90 gm. bread, 160 gm. butter, 206.3 gm. egg, etc. (153.6 gm. fat, 53.4 gm. carbohydrates, 24.6 gm. alcohol).	4	15.0	12.3	1.8	+0.9	Diabetes. Energy in food, 2,209 calories; in urine, 39 calories; in feces, 77 calories; gain, 2,093 calories.
1933	1895	.....do	Farmer	57	....	200 gm. beef, 200 gm. veal, 80 gm. bread, 180 gm. butter, 327.5 gm. egg, etc. (182.4 gm. fat, 49.4 gm. carbohydrates, 122.3 gm. alcohol).	2	20.4	17.9	1.1	+1.4	Diabetes. Energy in food, 3,278 calories; in urine, 278 calories; in feces, 71 calories; gain, 2,929 calories.
1934	1895	.....do	Man	44	....	250 gm. beef, 200 gm. veal, 80 gm. bread, 130 gm. butter, 217.5 gm. egg, etc. (131.6 gm. fat, 49.4 gm. carbohydrates, 92.3 gm. alcohol).	2	22.0	22.0	1.2	—1.2	Diabetes. Energy in food, 2,635 calories; in urine, 105 calories; in feces, 67 calories; gain, 2,463 calories.
1935	1895	.....do	Woman	63	....	275 gm. beef, 150 gm. veal, 99 gm. bread, 160 gm. butter, 320 gm. egg, etc. (166.3 gm. fat, 54.7 gm. carbohydrates, 49.2 gm. alcohol).	2	24.2	19.8	2.3	+2.1	Diabetes. Energy in food, 2,736 calories; in urine, 83 calories; in feces, 120 calories; gain, 2,533 calories.
1936	1895	.....do	Merchant	39	....	350 gm. beef, 200 gm. veal, 144.7 gm. egg, etc. (148.2 gm. fat, 0.6 gm. carbohydrates, 49.5 gm. alcohol).	8	23.0	21.5	0.5	+1.0	Diabetes. Energy in food, 2,316 calories; in urine, 33 calories; in feces, 53 calories; gain, 2,230 calories.
1937	1895	.....do	Laborer	33	....	525 gm. beef, 160 gm. butter, 247.5 gm. egg, etc. (158.8 gm. fat).	2	24.5	19.7	0.7	+4.1	Diabetes. Energy in food, 2,103 calories; in urine, 91 calories; in feces, 55 calories; gain, 1,957 calories.
1938	1895	.....do	Merchant	30	....	300 gm. beef, 200 gm. veal, 80 gm. bread, 180 gm. butter, 373.6 gm. egg, etc. (137.7 gm. fat, 48.9 gm. carbohydrates, 61.5 gm. alcohol).	3	26.8	22.7	2.3	+1.8	Diabetes. Energy in food, 3,063 calories; in urine, 145 calories; in feces, 103 calories; gain, 2,815 calories.

TABLE 18.—*Experiments with subjects with constitutional diseases*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1939	1895	Pautz	Man	29	......	400 gm. beef, 200 gm. veal, 180 gm. butter, 371.7 gm. egg, etc. (187.6 gm. fat, 0.9 gm. carbohyorates, 61.5 gm. alcohol).	3	28.9	26.9	1.6	+0.4	Diabetes. Energy in food, 2,920 calories; in urine, 37 calories; in feces, 78 calories; gain, 2,805 calories.
1940	1895	....do	Moulder	38	......	400 gm. beef, 219 gm. egg, etc. (82.0 gm. fat, 0.9 gm. carbohydrates, 74.2 gm. alcohol).	2	26.1	20.3	3.4	+2.4	Diabetes. Energy in food, 1,954 calories; in urine, 112 calories: in feces, 159 calories; gain, 1,683 calories.
1941	1895	....do	Manufacturer	32	......	400 gm. beef, 200 gm. veal, 90 gm. bread, 180 gm. butter, 477.5 gm. egg, etc. (198.7 gm. fat, 55.4 gm. carbohydrates, 152.3 gm. alcohol).	2	32.3	31.2	2.1	—1.0	Diabetes. Energy in food, 3,969 calories; in urine, 39 calories; in feces, 124 calories; gain, 3,806 calories.
1942	1895	....do	Bookkeeper	20	......	300 gm. beef, 200 gm. veal, 130 gm. butter, 315 gm. egg, etc. (140.7 gm. fat, 0.9 gm. carbohydrates, 61.5 gm. alcohol).	2	24.4	22.7	0.4	+1.3	Diabetes. Energy in food, 2,368 calories; in urine, 118 calories; in feces, 25 calories; gain, 2,225 calories.
1943	1886	Mikhalevitch	Soldier (K.)	23	66.3	597 gm. bread, 300 gm. meat, 619 gm. oatmeal, 693 gm. soup, 1,470 cc. water.	5	21.5	15.1	2.3	+4.1	Scurvy. Ordinary hospital diet.
1944	1886	....do	....do	23	65.5	683 gm. bread, 521 gm. meat, 1,000 cc. milk, 1,608 cc. water.	6	32.1	23.4	2.1	+6.6	Scurvy. Meat and milk diet.
1945	1886	....do	....do	23	66.2	558 gm. bread, 300 gm. meat, 503 gm. oatmeal, 997 gm. sour cabbage soup, 178 gm. buckwheat gruel, 125 gm. okroshka (= a mixture of kvass and hash) 352 gm. kvass.	5	22.9	17.9	3.1	+1.9	Scurvy. Hospital diet for scurvy.
1946	1886	....do	....do	23	73.1	649 gm. bread, 300 gm. meat, 537 gm. oatmeal, 1,229 gm. soup, 1,330 cc. water.	5	22.5	22.2	2.2	—1.9	Four and a half months after recovery.
1947	1886	....do	....do	23	73.3	502 gm. bread, 600 gm. meat, 1,190 cc. milk, 1,494 cc. water.	5	33.9	30.4	2.2	+1.3	Do.
1948	1886	....do	....do	23	74.0	621 gm. bread, 300 gm. meat, 538 gm. oatmeal, 1,010 gm. sour cabbage soup, 131 gm. buckwheat gruel, 163 gm. okroshka, 1,084 cc. kvass.	5	23.0	18.8	3.6	+0.6	Do.

1949	1886	.....do	Soldier (V.).........	24	51.4	432 gm. bread, 300 gm. meat, 390 gm. oatmeal. 422 gm. soup, 1,340 cc. water.	5	18.5	13.5	2.7	+2.3	Scurvy. Ordinary hospital diet.
1950	1886	.....do	.....do	24	51.9	550 gm. bread, 506 gm. meat, 1,000 cc. milk, 1,775 cc. water.	6	29.5	25.0	3.6	+0.9	Scurvy. Meat and milk diet.
1951	1886	.....do	.....do	24	52.1	523 gm. bread, 300 gm. meat, 520 gm. oatmeal, 654 gm. sour cabbage soup, 175 gm. buckwheat gruel, 81 gm. okroshka, 382 cc. kvass.	5	21.6	17.2	3.2	+1.2	Scurvy. Hospital diet for scurvy.
1952	1886	.....do	.....do	24	63.6	680 gm. bread, 300 gm. meat, 473 gm. oatmeal, 1,215 gm. soup, 1,440 cc. water.	5	22.9	22.6	2.1	−1.8	Four and a half months after recovery.
1953	1886	.....do	.....do	24	63.9	685 gm. bread, 600 gm. meat, 1,200 cc. milk, 1,682 cc. water.	5	37.2	30.1	3.3	+3.8	Do.
1954	1886	.....do	.....do	24	64.8	668 gm. bread, 300 gm. meat, 541 gm. oatmeal, 872 gm. sour cabbage soup, 82 gm. buckwheat gruel, 146 gm. okroshka, 1,028 cc. kvass.	5	22.9	19.5	4.5	−1.1	Do.

No. 1858. Ztschr. klin. Med., 1, p. 533. Nos. 1859–1861. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 2, p. 116. Nos. 1862–1866. Ibid., p. 120. Nos. 1867–1869. Ibid., p. 122. Nos. 1870–1875. Ueber den Stoffwechsel einer Diabetiker. Inaug. Diss., Dorpat, 1866, p. 24. Nos. 1876, 1877. Vrach, 9, p. 708. Nos. 1878–1881. Ibid, 11, Table 1, p. 1024. No. 1882. Ibid., p. 1025, Table 2. Nos. 1883, 1884. Ztschr. Biol., 29, pp. 133, 134. No. 1885. Ibid., p. 136. No. 1886. Ibid., p. 138. Nos. 1887–1891. Ztschr. klin. Med., 22, p. 240. Nos. 1892–1896. Ibid., p. 243. Nos. 1897–1912. Deut. med. Wochenschr., 1893, pp. 990, 991. Nos. 1913, 1914. Ein Beitrag zur Kentniss der Fettresorption in Diabetes mellitus. Inaug. Diss. Strassburg, 1893, p. 14. No. 1915. Ztschr. Biol., 32, p. 206. Nos. 1916, 1917. Ibid., p. 208. No. 1918. Ibid., p. 210. Nos. 1919, 1920. Ibid., p. 212. No. 1921. Ibid., p. 214. Nos. 1922, 1923. Ibid., p. 216. Nos. 1924, 1925. Ibid., p. 218. Nos. 1926, 1927. Ibid., p. 220. No. 1928. Ibid., p. 222. Nos. 1929, 1930. Ibid., p. 224. No. 1931. Ibid., p. 226. Nos. 1932, 1933. Ibid., p. 228. Nos. 1934, 1935. Ibid., p. 230. No. 1936. Ibid., p. 232. Nos. 1937, 1938. Ibid., p. 234. Nos. 1939, 1940. Ibid., p. 236. Nos. 1941, 1942. Ibid., p. 238. Nos. 1943–1948. Metabolism and assimilation of protein in scurvy patients. Inaug. Diss. (Russian), St. Petersburg, 1886, Table 1. Nos. 1949–1954. Ibid., Table 2.

No. 1858. See No. 1487, Table 17.

Nos. 1859–1869 were made by Vogel at the Charité Hospital in Berlin in 1892. The object was to study the effect of gout on metabolism. The subjects were 3 men suffering from gout, who were patients in the hospital. Two experiments (Nos. 818 and 819, Table 9) made by von Noorden with a healthy man, a laboratory servant, are also reported for purposes of comparison. The food consisted of a mixed diet of bread, potatoes, beans, etc. With a few exceptions it was all analyzed. In a number of cases pipirizin was taken as a remedial agent. This increased the daily nitrogen consumption materially. The nitrogen and fat in the feces were determined, and also the total nitrogen, urea, uric acid, and xanthin compounds in the urine. The ammonia in the urine was determined by difference. With each of the three patients there was a marked retention of nitrogen, although, as the author remarks, there was nothing in the diet or condition of the patient which indicated that such would be the case. In two cases this was more marked after taking pipirizin, yet von Noorden's experiment with a healthy man showed that this substance did not cause a retention of nitrogen.

The nitrogen metabolism in cases of gout is regarded as very like that in cases of disease of the kidneys. It was found that the assimilation of fat was about the same as in the case of normal individuals, while the assimilation of nitrogen was apparently not nearly as good. The conclusion is also reached that in cases of gout there is often a proportional increase in the excretion of uric acid, xanthin, etc., owing to a decrease in the amount of urea excreted. An absolute increase in the uric-acid excretion is, however, doubtful, and for xanthin, etc., is certainly not the case.

The article contains much historical and other information interesting from a medical standpoint.

Nos. 1870–1875 were made by Gaehtgens at the medical department of the University of Dorpat in 1866. The object was a comparison of the metabolism of a man with diabetes with that of a healthy individual. The healthy individual was the investigator himself. He was 1.679 meters tall. The other subject was a man who had diabetes. He was 1.62 meters tall. The food consisted of milk, butter, soup, meat, white bread, rye bread, bolted rye bread, etc. Tea, coffee, and water were used as beverages. In experiments Nos. 1872 and 1873 sodium bicarbonate was taken with the food, and in Nos. 1874 and 1875 sodium benzoate. The two subjects occupied the same room and performed approximately the same amount of work. The composition of the food and feces was computed from the figures obtained by Voit, Ranke, C. Schmidt, Barral, and Bidder and Schmidt. The urea, sodium chlorid, and sulphuric and phosphoric acids, the specific gravity and reaction of the urine of both subjects and the sugar in the diabetic urine were determined, and on 6 days the kreatin and on 5 days (the sodium benzoate period) the hippuric acid also. Records of temperature, pulse, respiration, and variation in weight were also kept in each test. The metabolism of the two subjects is discussed in detail. An attempt was made to compute the balance of hydrogen, oxygen, and water. The results are not included in the tables, since no account is taken of respiratory products. In the first and second tests the man with diabetes lost and the healthy subject gained nitrogen. In the third test both gained nitrogen.

Nos. 1876 and 1877 were made by Levin. The object was an investigation of the metabolism of phosphorus and nitrogen in diabetes mellitus. The subject was a merchant suffering from intermittent diabetes. The experiment lasted 10 days and was divided into two equal periods. In the first period the conditions were normal and in the second the patient took daily a half-hour bath of 35° C. The food consisted of a mixed diet. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method, and the phosphorus by titrating with urarium acetate (Pincus method).

The author sums up his results as follows: To draw conclusions concerning the metabolism of phosphorus from the amount of the phosphates in the urine is even

less permissible than to judge of the metabolism of nitrogen by the amount of nitrogen in the urine. In the above experiment the subject excreted considerably more phosphates than a healthy man, but he excreted much less than he assimilated, so that the mean metabolism of phosphates for 10 days was 78.36 per cent. This is considerably less than the normal amount for a healthy man (about 89 per cent). The mean metabolism of nitrogen was 89.86 per cent. The metabolism of phosphorus, as compared with the metabolism of nitrogen, was, therefore, considerably lower than in a healthy man.

The tepid baths produced a slight increase in the metabolism of nitrogen. Whether the marked increase in the metabolism of phosphorus (from 68.55 to 94.67 per cent) during the bath period is to be ascribed to the influence of the tepid baths can be settled only by further investigations.

Nos. 1878–1882 were made by Jawein. The object was to study the metabolism of nitrogen in diabetes. Two experiments were completed and a third was begun but not finished. The first experiment (Nos. 1878–1881) was divided into four periods. In the first period (7 days) the conditions were normal; in the second (5 days) the patient received 10 grams of sodium bicarbonate daily; in the third period (4 days) an abundant though not absolute protein diet was maintained, and in the fourth period (5 days) the conditions were again normal.

The second experiment (No. 1882) consisted of one period under usual conditions.

The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method; the nitrogen of the urea by the Borodin method. The extractives were separated with Chavane and Richet's reagent. Uric acid was estimated by the Haycraft method.

The author draws the following conclusions: While using sodium bicarbonate the metabolism of nitrogen was considerably lowered, viz, from 99.79 to 93.82 per cent, the quantity of extractives decreased, the quantity of uric acid increased, and the assimilation of nitrogen was not changed.

The influence of sodium bicarbonate on the quantity of sugar in the urine was not clear in these experiments.

On a very abundant protein diet the metabolism of nitrogen increased from 99.79 per cent to 127.86 per cent, the assimilation of nitrogen decreased, the quantity of nitrogen of extractives increased, the ratio of nitrogen of extractives to that of urea increased, and the quantity of uric acid also increased.

Nos. 1883–1886 were made by Fritz Voit in the laboratory of the Physiological Institute at Munich in 1891(?). The object was to see whether a person with diabetes required more protein than a normal individual when the diet consisted of protein and fat only and would produce very little sugar. The subjects were a healthy man and a man suffering from diabetes. The latter had been in the Munich hospital for some time, and as he followed a dietary which contained no carbohydrates the amount of sugar excreted in the urine was very small.

The first experiment lasted 6 days and the second 4 days. The diet during the experiments consisted of meat, milk, butter, bacon, and wine. It contained hardly enough protein to supply the needs of either individual, for on the third day of each experiment there was a loss of nitrogen, the amount being about the same in each case. Food, urine, and feces were analyzed. The conclusion is reached that the two organisms utilized the diet in practically the same way and to as much advantage in one case as the other. Fat was a protector of protein in each case. When the diet contains carbohydrates the diseased organism requires more protein and fat than the normal, simply because carbohydrates can not be utilized to protect protein. There is, however, a tendency even in the diseased organism to utilize carbohydrates, as was shown by No. 1883. On the day following No. 1884 the subject consumed 164 grams of milk sugar and the same amount of protein and fat as before. Only 70 grams of sugar reappeared in the urine. The total nitrogen excreted was only 14.9 grams. On the previous day it was 17.3 grams.

Voit discusses the problem of metabolism in diabetes at considerable length and refers to the greater part of the work which had been done on this subject.

Nos. 1887–1896 were made by Leo at the University of Bonn in 1891–92 The object was to study the effect of carbohydrates on the excretion of nitrogen in diabetes. The subjects were a woman and a man suffering from diabetes mellitus. For a period of several days a mixed diet was followed. Then for several days the amount of carbohydrates consumed was considerably increased. This alternation of diet was repeated, and the experiment closed in each case with a day of normal diet. The subjects were practically in nitrogen equilibrium at the beginning of the experiment. The nitrogen in food, urine, and feces was determined, and also the sugar in the urine.

The conclusion is reached that the increased consumption of carbohydrates diminishes the excretion of nitrogen.

Other experiments are reported which are not of the sort tabulated in the present compilation.

Nos. 1897–1912 were made by Burchard and Finkelstein at the Urban Hospital in Berlin in 1893. The objects were (1) to determine whether, the diet being the same, the nitrogen excreted by a diabetic patient differed from that of a normal individual, (2) to determine how much the protection of protein by carbohydrates differed in the case of a person with diabetes from that of normal individuals, and (3) if a person with diabetes really oxidized less carbohydrates than a healthy individual. It was believed that the "protective power" of a given quantity of carbohydrates would be less in case of diabetes than in health.

The investigators themselves were the subjects in the experiments with normal individuals. The subject in Nos. 1899 and 1906–1912 was a man suffering from diabetes. In Nos. 1897–1899 the food consisted of fish, meat, eggs, etc., and contained no carbohydrates. For 4 days before No. 1899 the subject had followed the same dietary and the urine had become sugar free. The nitrogen in food, urine, and feces was determined. In these experiments no difference was observed in the nitrogen metabolism of the three subjects. All lost a little in weight. The subject with diabetes, however, lost least.

In Nos. 1900–1908 the same mixed diet and a known quantity of dextrose was consumed. With such a diet the subject with diabetes excreted considerable sugar in the urine (about 40 grams when 50 grams was consumed). The protein metabolism, however, was very little different from that of the healthy individuals. The carbohydrates protected the protein in about the same way in every case. The subject with diabetes, however, lost weight, the others gained a little. In Nos. 1910-1912 the same diet as in No. 1897 was consumed, with the addition of levulose, milk sugar, or dextrose. It was found that the subject utilized the dextrose as a protector of protein as fully as the levulose and milk sugar, which were considered to be more easily combustible. In this case, as in the results of other observers, when milk sugar was consumed the urine contained grape sugar.

The article contains considerable discussion of theories of nutrition in diabetes.

Nos. 1913 and 1914 were made by Strauss at the Medical Institute of the University of Strassburg in 1893. The object was to study the nutritive value of fat in cases of diabetes mellitus. The subject was a man suffering from this disease in a very severe form. He had been in the hospital once before for treatment. During the experiment he employed his time with light work about the hospital.

The diet contained practically no carbohydrates. The food was carefully analyzed, with the exception of the butter and bacon. The composition of these was computed from analyses made by Weintraud in Neunyn's laboratory in Strassburg.

The urine and feces were analyzed. The diet contained a large quantity of fat—280.6 grams per day. Of this 92.6 to 92.8 per cent was assimilated. This does not differ much from Rubner's results (Nos. 413–416, Table 7) for the assimilation of fat by healthy individuals.

With a diet which contained 138 grams protein and 147 grams fat the subject excreted 17 grams of sugar per day in the urine.

The quantity of meat in the diet was diminished, but some sugar was still

excreted, and it was not until the subject fasted for 1 day that sugar disappeared from the urine.

The conclusion is reached that it is possible to maintain the protein balance of an individual with diabetes on a diet of meat and fat which contains no carbohydrates. This had been doubted by some investigators.

The diet exerted a beneficial effect on the organism. When 85 grams of protein was consumed at the beginning of the experiment sugar was excreted in the urine. After a time, however, the tendency to produce sugar diminished, showing that the organism was more nearly normal.

The article contains considerable matter relating to diabetes which is interesting from a medical standpoint.

Nos. 1915–1942 were made by Pautz in the laboratory of the Physiological Institute at Marburg in 1891–1893. The object was an investigation of the metabolism of persons with diabetes as compared with that of healthy individuals. The subjects were 7 men, 2 women, and a boy. The subjects of Nos. 1915–1918 were healthy individuals, the others were suffering from diabetes. The food was a simple mixed diet consisting of meat, bread, butter, eggs, etc., varying somewhat in the individual experiments. Most of the food was analyzed. For the nitrogen content of meat, however, Voit's figure, 3.4 per cent, was used. The urine and feces were analyzed. The fuel value of the food and feces was determined or calculated. That of the urine was calculated from the amount of sugar it contained.

The conclusion is reached that persons with diabetes do not, generally speaking, require more energy in the food than healthy individuals, and also that in the case of adults the disease does not increase metabolism.

Nos. 1943–1954 were made by Mikhalevitch in St. Petersburg in 1886. The object was an investigation of the metabolism and assimilation of protein in scurvy patients. Two experiments are described, each lasting 16 days at the time of the disease and 15 days four and a half months later when the patients had completely recovered. Each experiment was divided into three periods; the first, with ordinary hospital diet; the second, with a milk and meat diet; and the third, with the hospital diet for scurvy patients.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The sulphates were also determined in the food and exereta by titrating with a uranium solution.

The author sums up his results as follows: The assimilation of protein by scurvy patients was very satisfactory, and no less complete during the disease than after recovery. The assimilation of the milk and meat diet by the subjects both in health and with scurvy was better than that of the ordinary hospital diet. The scurvy diet was less completely assimilated than either the milk and meat diet or the ordinary hospital diet. The quantity of nitrogen assimilated by the patients when suffering from scurvy was greater and the quantity of nitrogen excreted daily in the urine was less than after recovery. The ratio of the phosphates to nitrogen was less, while the ratio of the sulphates to nitrogen was greater, during the disease than after recovery, while on the scurvy diet the ratio of the phosphates to nitrogen increased and the increase was more marked after recovery than during the diease.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM DISEASES OF THE DIGESTIVE SYSTEM.

In Table 19 are included 31 tests with men and 46 with women, in which the subjects were suffering from cancer of the œsophagus, cancer of the stomach, constipation, jaundice, and cirrhosis. These experiments were made to investigate special questions, which are noted in the text accompanying the table. A number of experiments in which the subjects were suffering from cancer of other than the digestive organs are also included in this table.

TABLE 19.—*Experiments with subjects with diseases of the digestive system.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1955	1889	Müller	Woman (K.)	38	43	94 cc. milk, 461 cc. coffee, 34.7 gm. zwieback, 46.9 gm. meat, 260 cc. soup, 55 cc. red wine.	8	4.0	6.3	5.1	—7.4	Carcinoma ventriculi.
1956	1889	....do	Woman (S.)	36	38.5	318 cc. milk, 525 cc. coffee, 325 gm. soup (2 days), 36 gm. meat, 45 gm. bread (1 day), 64 gm. zwieback (2 days), 48 gm. potatoes (2 days).	4	3.4	11.7	0.3	—8.6	Do.
1957	1889	....do	Woman (V.)	37	40	226 cc. milk, 300 cc. bouillon, 501 gm. bread, 150 cc. wine, 282 cc. coffee.	9	2.5	8.8	0.3	—6.6	Do.
1958	1889	....do	Woman (S.)	44	36	217 cc. milk, 217 cc. bouillon, 200 cc. coffee, 140 cc. wine, 35 gm. egg (5 days).	9	1.7	5.7	(0.3)	—4.3	Carcinoma pancreatis.
1959	1889	....do	Woman (M.)	52	48.4	1,168 cc. milk, 96.5 gm. bread, 57 gm. meat (2 days), 300 cc. coffee (1 day).	3	9.1	9.7	0.7	—1.3	Carcinoma mammæ.
1960	1889	....do	Woman (B.)	58	41	390 cc. milk, 300 cc. coffee, 25 gm. meat (2 days), 300 cc. bouillon.	5	2.5	8.0	(0.3)	—5.8	Carcinoma ventriculi.
1961	1889	....do	Clerk (H.)	43	......	1,955 cc. milk, 96.7 gm. white bread. 91.2 gm. meat, 20 gm. butter, 40 cc. alcohol (1,901 calories).	6	14.6	23.4	1.0	—9.8	Carcinoma penis.
1962	1889	....do	....do	43	......	3,000 cc. milk, bread, 40 gm. butter, 56 cc. alcohol, meat (3,067 calories).	3	20.8	20.7	1.2	—1.1	Do.
1963	1890	Gaertig	Lithographer	58	......	39.1 gm. egg, 2.2 gm. meat, 326.6 cc. milk, 74.4 cc. sherry (also 41.1 gm. peptones, 16.5 gm. egg yolk, 40 gm. grape sugar pro rectum).	9	7.3	11.5	0.5	—4.7	Carcinoma œsophagi. Cl in food, 0.5 gm.; in urine, 0.4 gm.; in feces, 0.0; gain, 0.1 gm.
1964	1892	Laudenheimer	Woman	54	......	1,000–2,000 cc. milk, soup, egg, coffee, 140 cc. sherry (800–900 calories).	5	8.9	10.4	0.5	—2.0	Carcinoma cervicis.
1965	1892	....do	Woman	63	......	Milk, soup, egg, 140 cc. sherry, bread, potatoes (1 day), 200–600 cc. water.	8	......	......	......	......	Carcinoma uteri et cervicis. NaCl in food, 9.8 gm.; in urine, 9.4 gm.; in feces, 0.4 gm.; gain or loss, 0.
1966	1892	....do	....do	63	......	....do	4	......	......	......	......	Carcinoma uteri et cervicis. First 4 days of No. 1965. NaCl in food, 9.4 gm.; in urine, 11.6 gm.; in feces, 0.4 gm.; loss, 2.6 gm.

1967	1892	....do	....do	63	......	Same as No. 1965	4	......	......	......	......	Carcinoma uteri et cervicis. Last 4 days of No. 1965. NaCl in food, 10.2 gm.; in urine, 7.1 gm.; in feces, 0.4 gm.; gain, 2.7 gm.
1968	1892	....do	Man	53	......	1,000-2,000 cc. milk, soup, egg, 140 cc. sherry, bread, meat, and sausage (1 day), 300 cc. seltzer water.	6	16.1	10.2	1.2	+ 4.7	Carcinoma pulmon. et mediastinæ. Subject was given 100 cc. saturated solution of morphium citrate and sulfonal. NaCl in food, 13.5 gm.; in urine, 8.2 gm.; in feces, 0.5 gm.; gain, 4.8 gm.
1969	1892	....do	....do	53	......	....do	3	16.7	10.4	1.2	+ 5.1	Carcinoma pulmon. et mediastinæ. Subject was given 100 cc. saturated solution of morphium citrate and sulfonal. First 3 days of No. 1968. NaCl in food, 12.9 gm.; in urine, 9.9 gm.; in feces, 0.5 gm.; gain, 2.5 gm.
1970	1892	....do	....do	53	......	....do	3	15.5	10.1	1.2	+ 4.2	Carcinoma pulmon. et mediastinæ. Subject was given 100 cc. saturated solution of morphium citrate and sulfonal. Last 3 days of No. 1968. NaCl in food, 14.2 gm.; in urine, 6.6 gm.; in feces, 0.5 gm.; gain, 7.1 gm.
1971	1892	....do	....do	67	......	Milk, soup, bread, egg, 140 cc. sherry, meat, rice.	8	2.8	4.8	0.7	— 2.7	Carcinoma ventriculi. Nitrogen in food. Average of 7 days. NaCl in food, 2.2 gm.; in urine, 3.0 gm.; in feces, 0.1 gm.; loss, 1.1 gm.
1972	1893	Schöpp	Woman (K.)	37	......	1,000 cc. milk, meat, butter, bread, etc., 3.9 gm. salt.	21	28.5	18.0	(2.1)	+ 8.4	Carcinoma uteri. NaCl in food, 10.6 gm.; in urine, 6.3 gm.; in feces, 0.6 gm.; gain, 3.7 gm.
1973	1893	....do	Woman (Z.)	62	......	500 cc. milk, meat, butter, bread, etc., 3 gm. salt.	8	......	......	......	......	Carcinoma uteri. NaCl in food, 6.9 gm.; in urine, 3.8 gm.; in feces, 0.3 gm.; gain, 2.8 gm.

TABLE 19.—*Experiments with subjects with diseases of the digestive system*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
1974	1893	Schöpp	Woman (S.)	58		714.3 cc. milk, 500 cc. coffee, egg, bread, 0.2 gm. salt.	8	11.3	14.9	(1.6)	—4.2	Carcinoma ventriculi. NaCl in food, 3.6 gm.; in urine, 4.1 gm.; in feces, 0.1 gm.; loss, 0.6 gm.
1975	1893	do	Woman (G.)	71		648.3 cc. milk, meat, egg, bread, 1.6 gm. salt.	15	25.8	23.7	(2.1)	0.0	Carcinoma mammæ. NaCl in food, 8.0 gm.; in urine, 7.5 gm.; in feces, 0.5 gm.; gain or loss, 0.
1976	1893	do	do	71		500 cc. milk, 150 gm. meat, 230 gm. bread, etc.	1	26.3	23.5	(2.1)	+0.7	Carcinoma mammæ. Last day of No. 1975. NaCl in food, 7.7 gm.; in urine, 5.1 gm.; in feces, 0.8 gm.; gain, 1.8 gm.
1977	1886	Cheltsov	Soldier	24	59.6	Bread, meat, milk, water	3	31.4	21.9	1.5	+8.0	Catarrhus gastro intestinalis chronicus. Subject took 6 gm. extr. absinthii twice a day.
1978	1886	do	do		39.3	do	9	24.9	23.8	2.7	—1.6	Catarrhus gastro intestinalis chronicus.
1979	1886	do	do		58.8	do	3	28.2	20.8	2.1	+5.3	Do.
1980	1886	do	Conductor	40	57.0	do	2	17.2	12.7	2.6	+1.9	Catarrhus gastro intestinalis chronicus. Subject took 5 gm. extr. quassia twice a day.
1981	1886	do	do		56.5		8	14.2	10.4	4.4	—0.6	Catarrhus gastro intestinalis chronicus.
1982	1886	do	do		56.6	do	3	17.5	14.1	2.9	+0.5	Catarrhus gastro intestinalis chronicus. Nitrogen in urine and feces=average of 4 days.
1983	1886	do	do	40	57.1	do	2	18.9	15.2	1.9	+1.8	Catarrhus gastro intestinalis chronicus. Subject took 2½ gm. extr. quassia twice a day.
1984	1886	do	do		56.8	do	7	15.1	13.2	2.5	—0.6	Catarrhus gastro intestinalis chronicus.

1985	1886	....do	....do	....	56.8	....do	1	17.6	13.1	1.6	+2.9	Do.
1986	1887	Müller	Student	....	....	2,500 cc. milk, 207.5 gm. white bread	2	15.6	17.8	1.7	—3.9	Normal health.
1987	1887	....do	Man	45	....	2,000 cc. milk, 3.5 gm. butter, 75.2 gm. white bread, 50.0 gm. water (2 days).	3	11.1	10.8	0.9	—0.6	Icterus following cholelithiasis.
1988	1887	....do	....do	38	....	2,563 cc. milk, 227.9 gm. white bread	3	16.3	15.9	2.2	—1.8	Cholelithiasis cirrhosis hepatis.
1989	1887	....do	....do	38	....	597 gm. meat, 13.3 gm. butter, 148.3 gm. white bread.	3	22.5	17.2	6.3	—1.0	Do.
1990	1887	....do	Woman	32	....	2,000 cc. milk, 310.6 gm. white bread	3	13.1	17.4	1.6	—5.9	Echinococus hepatis.
1991	1887	....do	....do	32	....	505 gm. meat, 20 gm. butter, 61.5 gm. white bread, 500 cc. beer.	2	18.2	17.4	1.3	—0.5	Phthisis pulmonum, starchy degeneration of the intestines and glandularium mesariacum.
1992	1887	....do	....do	30	....	1,696.7 cc. milk, 121.3 gm. white bread	3	9.7	6.6	1.0	+2.1	Do.
1993	1890	Von Noorden	Woman (G.)	19	57.0	1,000 gm. milk, 233 gm. meat, 152 gm. white bread, 37 gm. butter (170.3 gm. fat).	3	17.5	15.7	1.2	+0.6	Disease of the stomach. A little carbohydrates was lost by vomiting.
1994	1890	....do	Woman (B.)	36	50.0	197 gm. milk, 152 gm. white bread, 30 gm. butter (3 days), 83 gm. meat, 65 gm. egg, 16 gm. salt (1 day) (29 gm. fat, 99.9 gm. carbohydrates).	5	6.9	7.1	0.6	—0.8	Do.
1995	1890	....do	Woman (M.)	32	50.5	1,000 gm. milk, 133 gm. white bread, 45 gm. butter, 153 gm. meat, 360 gm. cream, 20 gm. salt (1 day) (88.5 gm. fat, 181.1 gm. carbohydrates).	4	13.9	11.6	1.2	+1.1	Do.
1996	1890	....do	Woman (L.)	43	44.0	315 gm. meat, 232.3 gm. white bread, 37.3 gm. butter, 4 gm. salt (64.8 gm. fat, 181.6 gm. carbohydrates).	3	19.3	13.3	1.6	+4.4	Disease of the stomach.
1997	1890	....do	....do	43	44.5	930 gm. milk, 375 gm. meat, 226 gm. white bread, 50 gm. butter, 5 gm. salt (76.7 gm. fat, 182.2 gm. carbohydrates).	3	22.0	16.7	1.3	+4.0	Do.
1998	1890	....do	Woman (J.)	30	40.5	966.7 gm. milk, 77.3 gm. white bread, 231 gm. meat, 41.7 gm. butter, 6 gm. salt (67.4 gm. fat, 31.1 gm. carbohydrates).	3	14.1	12.1	1.3	+0.7	Do.
1999	1890	....do	....do	30	41.0	1,333.3 gm. milk, 233.3 gm. meat, 103.7 gm. bread, 61.7 gm. butter, 2.7 gm. salt (96.2 gm. fat, 123.1 gm. carbohydrates).	3	16.8	13.4	1.4	+2.0	Do.
2000	1890	....do	....do	30	41.0	1,433.3 gm. milk, 158.7 gm. meat, 127 gm. white bread, 66.6 gm. butter, 6 gm. salt (140 gm. fat, 141 gm. carbohydrates).	3	17.2	14.3	1.1	+1.8	Do.
2001	1890	....do	....do	30	41.5	950 gm. milk, 96.6 gm. egg, 200 gm. meat, 8.3 gm. sugar, 96 gm. white bread, 75 gm. butter, 3.3 gm. salt, 99 gm. zwieback (109.4 gm. fat, 164.6 gm. carbohydrates).	3	17.3	13.7	1.3	+2.3	Do.
2002	1890	....do	....do	30	42.0	65.5 gm. butter, 96.1 gm. white bread, 59.8 gm. zwieback, 97.4 gm. egg, 157.9 gm. meat, 1,490.6 gm. milk, 5 gm. salt, 31.3 gm. salmon, 10 gm. cod liver oil (126.1 fat, 166 gm. carbohydrates).	8	20.0	14.9	1.1	+4.0	Do.

TABLE 19.—*Experiments with subjects with diseases of the digestive system*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm*	*Gm.*	
2003	1890	Von Noorden	Woman (J.)	30	45.0	47.7 gm. butter, 36.1 gm. ham, 62.6 gm. white bread, 53.1 gm. zwieback, 97.1 gm. egg, 1,442.9 gm. milk, 94.6 gm. meat, 24.6 gm. potato, 28.6 gm. grape sugar, 4 gm. salt (97.2 gm. fat, 9 gm. carbohydrates).	7	18.0	12.7	1.2	+ 4.1	Disease of the stomach.
2004	1890	....do	....do	30	45.5	55 gm. bread, 66.5 gm. zweiback, 73.9 gm. egg, 107 gm. meat, 27.7 gm. ham, 1,500 gm. milk, 45 gm. sugar, 58.8 gm. butter, 76.3 gm. potato, 5.3 gm. salt (108.4 gm. fat, 206 gm. carbohydrates).	6	18.2	13.5	1.3	+ 3.4	Do.
2005	1890	....do	Woman (K.)	27	50.3	633.3 gm. milk, 76.3 gm. white bread, 75 gm. butter, 200 gm. meat, 109 gm. zwieback, 1.7 gm. salt, 96.4 gm. egg (101 gm. fat, 149.1 gm. carbohydrates).	3	16.3	11.1	1.1	+ 4.1	Do.
2006	1890	....do	Woman (M.)	25	59.5	950 gm. milk, 226.7 gm. white bread, 94.3 gm. butter, 300 gm. meat, 12.7 gm. zwieback, 2.7 gm. salt (112.2 gm. fat, 187.7 gm. carbohydrates).	3	19.3	14.9	1.6	+ 2.8	Do.
2007	1890	....do	Woman	22	......	1,000 gm. milk, 210 gm. meat, 40 gm. butter, 154.3 gm. white bread, 82.3 gm. egg, 283.3 gm. soup, 3.3 gm. salt (80 gm. fat, 154 gm. carbohydrates).	3	17.2	19.2	1.5	— 3.5	Normal health.
2008	1890	....do	....do	22	......	1,000 gm. milk, 154.7 gm. white bread, 210 gm. meat, 40 gm. butter, 85.3 gm. egg, 300 gm. soup, 3.3 gm. salt (80 gm. fat, 155 gm. carbohydrates).	3	17.3	17.2	1.8	— 1.7	Normal health. Subject took calcium carbonate.
2009	1894	Sachse	Woman	36	......	1,000 gm. milk, 174 gm. white bread, 80 gm. butter, 110 gm. egg, 127 gm. meat (117.4 gm. fat).	3	14.2	8.5	0.9	+ 4.8	Cholecystostomy had been performed.
2010	1894	.... o	....do	36	......	1,000 gm. milk, 166 gm. white bread, 75 gm. butter, 98 gm. egg, 131 gm. meat (107.9 gm. fat).	3	13.5	8.9	0.8	+ 3.8	Do.
2011	1888	Favitski	Man (P.)	33	39.6	447 gm. bread, 344 gm. soup, 138 gm. meat, 80 gm. cutlet (1 day), 50 gm. blackberries (1 day), 1,800 cc. tea.	5	15.3	11.4	1.7	+ 2.2	Cirrhosis hepatis atrophica.

2012	1888	.....do	.....do	33	39.4	395 gm. bread, 275 cc. soup (1 day), 153 gm. meat, 69 gm. cutlet, 55 gm. blackberries (1 day), 1,800 cc. tea.	5	18.3	12.1	2.6	+ 3.6	Cirrhosis hepatis atrophica. Subject was given potassium iodid.
2013	1888	.....do	.....do	33	39.6	381 gm. bread, 52 cc. soup (2 days), 140 gm. meat, 56 gm. cutlet, 80 gm. blackberries, 2,200 cc. tea.	6	17.5	12.2	2.1	+ 3.2	Cirrhosis hepatis atrophica. Subject was given alkaline treatment.
2014	1888	.....do	Retired soldier (B.).	48	47.5	509 gm. bread, 1,630 cc. soup, 150 gm. meat, 62 gm. cutlet, 52 gm. blackberries (1 day), 2,170 cc. tea.	4	21.3	16.4	3.9	+ 1.0	Cirrhosis hepatis atrophica.
2015	1888	.....do	.....do	48	48.2	378 gm. bread, 1,604 cc. soup, 264 gm. meat, 96 gm. cutlet, 45 gm. blackberries (1 day), 2,690 cc. tea.	6	24.8	16.4	3.8	+ 4.6	Cirrhosis hepatis atrophica. Subject was given Carlsbad salts.
2016	1888	.....do	.....do	48	49.2	462 gm. bread, 1,793 cc. soup, 208 gm. meat, 84 gm. cutlet, 47 gm. blackberries, 2,170 cc. tea.	4	22.9	13.0	3.8	+ 6.1	Cirrhosis hepatis atrophica. Faradization.
2017	1888	.....do	.....do	48	48.8	505 gm. bread, 1,865 cc. milk, 52 gm. blackberries (2 days), 2,170 cc. tea.	5	18.4	14.0	1.6	+ 2.8	Cirrhosis hepatis atrophica. Milk diet.
2018	1888	.....do	Peasant (K.)	34	55.4	606 gm. bread, 531 cc. soup, 84 gm. meat, 77 gm. cutlet, 1,198 cc. milk (2 days), 56 gm. blackberries (1 day), 575 cc. tea.	5	22.4	19.2	2.6	+ 0.6	Cirrhosis hepatis atrophica.
2019	1888	.....do	.....do	34	56.4	746 gm. bread, 983 cc. soup, 163 gm. meat, 88 gm. cutlet, 60 gm. blackberries (1 day), 1,380 cc. tea.	8	29.3	22.9	2.2	+ 4.2	Cirrhosis hepatis atrophica. Subject was given Carlsbad salts.
2020	1888	.....do	.....do	34	57.5	1,071 gm. bread, 428 cc. soup, 157 gm. meat, 84 gm. cutlet, 70 gm. blackberries (1 day).	7	35.8	22.6	3.1	+10.1	Cirrhosis hepatis atrophica. Faradization.
2021	1888	.....do	Peasant (L.)	23	60.3	1,013 cc. milk, 619 gm. bread, — gm. cutlet, — gm. meat, — gm. soup, 900 cc. tea.	8	24.6	12.9	2.5	+ 9.2	Cirrhosis hepatis atrophica.
2022	1888	.....do	Woman (Sh.)	32	66.6	2,653 cc. milk, 52 gm. blackberries (1 day)	7	14.5	9.4	2.4	+ 2.7	Cirrhosis hepatis atrophica. Subject was given Carlsbad salts.
2023	1888	.....do	.....do	32	56.4	2,464 cc. milk	9	18.3	9.2	2.8	+ 6.3	Cirrhosis hepatis atrophica.
2024	1888	.....do	.....do	32	57.8	2,157 cc. milk, 123 gm. bread, 188 cc. bouillon, 293 gm. manna.	7	16.1	9.8	2.3	+ 4.0	Cirrhosis hepatis atrophica. Subject was given adonis vernalis.
2025	1888	.....do	.....do	32	61.9	1,734 cc. milk, 136 gm. bread, 188 cc. bouillon, 249 gm. manna, 61 gm. blackberries (1 day).	9	13.4	10.0	2.6	+ 0.8	Cirrhosis hepatis atrophica. Subject was given warm baths and Tinc. blatta orientalis.
2026	1888	.....do	Soldier (officer, K.)	26	......	175 gm. bread, 426 cc. soup, 43 gm. meat (1 day), 87 gm. cutlet, 650 cc. milk, 100 gm. blackberries (1 day), 200 cc. tea.	5	11.2	12.9	1.3	— 3.0	Cirrhosis hepatis atrophica.
2027	1888	.....do	.....do	26	65.2	143 gm. bread, 535 cc. soup, 78 gm. cutlet, 671 cc. milk, 70 gm. blackberries (1 day), 800 cc. tea.	4	10.1	12.8	1.0	— 3.7	Cirrhosis hepatis atrophica. Subject was given Carlsbad salts.
2028	1888	.....do	.....do	26	63.3	279 gm. bread, 1,746 cc. milk, 600 cc. tea	10	14.4	14.3	1.0	— 0.9	Cirrhosis hepatis atrophica. Milk diet.
2029	1888	.....do	.....do	26	61.0	299 gm. bread, 1,713 cc. milk, 70 gm. blackberries (1 day), 800 cc. tea.	5	14.7	12.6	1.9	+ 0.2	Cirrhosis hepatis atrophica. Milk diet. Subject was given caffein.

TABLE 19.—*Experiments with subjects with diseases of the digestive system*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (−).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2030	1888	Favitski	Marine (P.)	57	73.8	344 gm. bread, 2,333 cc. milk, 70 gm. blackberries (1 day), 2,180 cc. tea.	7	18.7	11.7	0.9	+ 6.1	Cirrhosis hepatis et cor lassum.
2031	1888	....do	....do	57	76.2	373 gm. bread, 2,313 cc. milk, 82 gm. blackberries (1 day), 2,180 cc. tea.	5	18.8	7.6	1.2	+10.0	Cirrhosis hepatis et cor lassum. Warm baths.
2032	1888	....do	....do	57	81.2	118 gm. bread, 2,436 cc. milk, 2,180 cc. tea	5	20.9	14.1	0.7	+ 6.1	Cirrhosis hepatis et cor lassum. Subject was given adonis vernalis.

No. 1955. Ztschr. klin. Med., 16, p. 515. No. 1956. Ibid., p. 519. Nos. 1957, 1958. Ibid., pp. 522, 523. No. 1959. Ibid., p. 525. Nos. 1960, 1961. Ibid., pp. 528, 529. No. 1962. Ibid., p. 530. No. 1963. Untersuchung Über Stoffwechsel in einen Fall von Carcinoma œsophagi. Inaug. Diss., Berlin, 1890, p. 21. No. 1964. Ztschr. klin. Med., 21, p. 520. Nos. 1965–1967. Ibid., p. 524. Nos. 1968–1970. Ibid., p. 528. No. 1971. Ibid., p. 532. Nos. 1972, 1973. Deut. med. Wochenschr., 1893, pp. 1158, 1159. Nos. 1974, 1975. Ibid., pp. 1213, 1214. No. 1976. Ibid., p. 1215. Nos. 1977–1979. The effect of bitter drugs on the digestion and assimilation of protein. Inaug. Diss. (Russian), 1886, Table, p. 3. Nos. 1980–1985. Ibid., pp. 75, 76. No. 1986. Ztschr. klin. Med., 12, p. 57. No. 1987. Ibid., p. 60. No. 1988. Ibid., p. 64. No. 1989. Ibid., p. 67. Nos. 1990, 1991. Ibid., pp. 70, 71. No. 1992. Ibid., p. 87. No. 1993. Ibid., 17, p. 143. No. 1994. Ibid., p. 145. No. 1995. Ibid., p. 148. Nos. 1996, 1997. Ibid., pp. 454, 455. Nos. 1998, 1999. Ibid., pp. 458, 459. Nos. 2000, 2001. Ibid., pp. 460, 461. No. 2002. Ibid., p. 463. No. 2003. Ibid., p. 464. Nos. 2004, 2005. Ibid., pp. 466, 467. No. 2006. Ibid., p. 469. Nos. 2007, 2008. Ibid., pp. 525, 526. Nos. 2009, 2010. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 3, pp. 9, 10. Nos. 2011–2013. Qualitative and quantitative metabolism of nitrogen in cases of cirrhosis of the liver. Inaug. Diss. (Russian), St. Petersburg, 1888, p. 30. Nos. 2014–2017. Ibid., p. 34. Nos. 2018–2020. Ibid., p. 38. No. 2021. Ibid., p. 42. Nos. 2022–2025. Ibid., p. 44. Nos. 2026–2029. Ibid., p. 48. Nos. 2030–2032. Ibid., p. 52.

Nos. 1955–1962, No. 1564, Table 17, and Nos. 2219–2226, Table 24, were made by Müller at the Charité Hospital in Berlin in 1886–1888. The object was to investigate the effect of carcinoma on metabolism. The subjects of Nos. 2219–2226, Table 24, were suffering from some mental trouble, but were otherwise healthy. They received a diet containing an insufficient amount of nitrogen and the experiments were made for purposes of comparison. The subjects of Nos. 1955–1962 were suffering from carcinoma, and the subject of No. 1564, Table 17, from typhus abdominalis.

The food consisted of meat, soup, eggs, etc. The feces were separated by means of charcoal. The nitrogen in the food, urine, and feces was determined, and in most cases the urea of the urine was also determined by titration (Pflüger's method).

The subject of No. 1959 died soon after the close of the experiment. With a diet containing 1 to 1.5 grams of nitrogen, this subject excreted in the urine an average of 2.9 grams of nitrogen daily during the 15 days before death occurred. On the first day the excretion of nitrogen was 5.2 grams and on the second day 6.6 grams. It then diminished steadily until on the fifteenth day it was 0.3 gram. The feces were not collected.

The author quotes two experiments with a woman 26 years old suffering from some mental trouble, in which no food was consumed. On the sixth day of fasting 4.2 grams of nitrogen was excreted in the urine. When a little bouillon and egg were consumed, 4.4 grams of nitrogen was excreted in the urine. The feces were not analyzed.

The conclusion is reached that carcinoma increases the metabolism of nitrogen. Even if the amount consumed was increased it was not possible to prevent a loss of nitrogen.

The medical aspect of these experiments is discussed at length and the literature is reviewed.

No. 1963 was made by Gaertig at the Charité Hospital in Berlin in 1889 (?) under the direction of von Noorden. The object was to investigate the metabolism of nitrogen and chlorin in cases of carcinoma. The subject was a man 58 years old suffering from carcinoma œsophagi. It was almost impossible for the subject to swallow much food or retain it on his stomach. He was therefore fed part of the time per rectum. The food taken per os consisted of eggs, meat, milk, and sherry. During the whole period a considerable amount (equal to 150 grams dry matter) was vomited. It contained 5.1 per cent nitrogen and 1.5 per cent sodium chlorid. The food taken per rectum consisted of peptone, egg yolk, and grape sugar. The composition of the meat and of the egg yolk was calculated from Voit's figures, the chlorin of the milk from König's figures. The composition of the remainder of the food and of the urine and feces was determined.

The following conclusions were reached: The assimilation of the nitrogen of peptones was very complete. Carcinoma caused a considerable breaking down of the protein of the organism.

Nos. 1964–1971 and No. 1817, Table 17, were made by Laudenheimer at the Medical Institute of the University of Berlin in 1891–92. The object was to investigate the excretion of chlorids in patients suffering from carcinoma.

The subjects were 2 women and 3 men, patients in Dr. Leyden's hospital. The subjects of Nos. 1964–1971 were suffering from cancer and the subject of Nos. 1817, 1818, Table 17, had phthisis. The latter experiment was made for purposes of comparison. The sodium chlorid and nitrogen in food, urine, and feces were determined. When food was vomited the sodium chlorid and nitrogen in it were also determined.

Several other experiments were made, in which the details were not complete enough for tabulation in the present compilation.

The conclusion of the author is that there is no characteristic change in the relation of excreted to consumed chlorids caused by carcinoma.

Nos. 1972–1976 were made by Schöpp at the Urban Hospital in Berlin in 1892. No. 1976 was made by Müller. The object was to study the metabolism and excretion of sodium chlorid in cases of carcinoma. The subjects were 4 women, hospital patients, suffering from carcinoma. The food consisted of beef, pork, veal, milk, rolls, eggs, artificial butter, coffee, and beer. The sodium chlorid in the milk,

butter, coffee, and bread, and in the urine and feces, was determined. It was calculated for the meat, eggs, and beer. The nitrogen in the food was also calculated, and that in the urine was determined. The nitrogen in the feces was supplied by the compilers from Cheltsov's experiments (Nos. 1979 and 1984) in which the nitrogen consumed was similar in amount.

The following conclusions were reached: The relation between the consumption and excretion of sodium chlorid was not constant for all cases of carcinoma. The very marked diminution in the amount of chlorin in certain cases of carcinoma is intimately connected with the retardation of the reconstructive processes, and is caused by the large amount of chlorin in the secretions due to ulceration. It is proportional to the growth of the morbid tissue and indirectly proportional to the wasting away of the tissues of the body. The idea had been advanced by some investigators that the diminution in the amount of chlorin excreted and the increased excretion of urea in carcinoma pointed to an analogy between this disease and acute fever. In the author's opinion this diminution in the amount of chlorin excreted in many cases of carcinoma does not point to the fact that cancerous diseases and fevers have anything in common as regards their origin. The result is produced by entirely different causes.

Nos. 1977–1985 and Nos. 2860–2868, Table 29, were made by Cheltsov in St. Petersburg in 1886. The special question studied was the influence of bitter drugs (amara) on the metabolism of nitrogen, though the gastric and pancreatic digestion, the secretion of bile, and intestinal fermentation were also studied. The subjects were men and dogs. The experiments with dogs (Nos. 2860–2868, Table 29) are described on page 330.

Three experiments were made with 2 men suffering from chronic derangement of digestion. The experiments were divided into three periods. In the first period bitter remedies (either extr. absinthii or extr. quassia) were given, and in the second and third periods the treatment was omitted. The food consisted of bread, meat, milk, and water. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The conclusion was reached that the assimilation of nitrogen diminished under the influence of bitter remedies.

Nos. 1986–1992 were made by Müller at the Charité Hospital in 1882–83, to study the effect of jaundice upon digestion and upon metabolism.

The subject in No. 1986 was a healthy man. The subjects in Nos. 1987–1989 were suffering from some form of jaundice, in Nos. 1990 and 1991 from echinococcus hepatis, and in No. 1992 from phthisis pulmonalis and starchy degeneration of the intestines and glandularum mesariacum. The investigation includes in addition several digestion experiments.

The food consisted of milk, white bread, butter, and in some cases lean beef in addition.

The nitrogen and fat in the milk and the fat in the meat were determined. The nitrogen in the meat was calculated, using Voit's value, 3.4 per cent. The separation of the feces was made with charcoal. The nitrogen, fat, and ash in the feces and the nitrogen in the urine were determined. In some cases the total sulphur, total combined sulphur, and neutral sulphur in the urine were also determined.

The conclusion is reached that in cases of simple jaundice the metabolism of protein is not affected. When the gall was prevented from entering the intestine the digestibility of starch was not materially changed, that of protein was very little changed, and that of ash was normal or better than in the case of healthy individuals. The digestibility of fat was not nearly as good as in the case of normal individuals. The experiments are discussed at length from a medical standpoint.

Nos. 1993–2008 were made by von Noorden at the Charité Hospital in Berlin in 1889–90. The object of Nos. 1993–2006 was to investigate the assimilation of food in diseases of the stomach. The object of Nos. 2007 and 2008 was to determine the effect of neutralizing the hydrochloric acid of the stomach with calcium carbonate. The subjects of Nos. 1993–2006 were hospital patients suffering from some disease of the stomach characterized by a deficiency of hydrochloric acid. The subject of Nos. 2007 and 2008 was well nourished and in good health.

The composition of the food was determined in some cases, in others calculated from known data. The nitrogen in the urine and the nitrogen and fat in the feces were determined.

The conclusion was reached that the assimilation of protein in the subjects with diseased stomachs was amply sufficient, though the food was not subjected to the normal stomach digestion with pepsin and hydrochloric acid. The very general diminution in the amount of nourishment assimilated by subjects with disease of the stomach is explained as due to weakness (marasmus). The discussion of the experiments and the other conclusions drawn are of a medical nature.

Nos. 2009 and 2010 were made by Sachse in Berlin in 1893. The object was to investigate the effect upon the absorption of nutrients of causing the gall to flow continuously into the intestine instead of periodically. The subject was a woman, a patient in the Charité Hospital. She had undergone the operation of cholecystostomy. The food consisted of milk, bread, butter, eggs, and meat. The nitrogen in the milk and meat and the fat in the milk and butter were determined. The nitrogen and fat in the bread and eggs were calculated. The nitrogen in the urine and feces and the fat in the feces were determined. The conclusion is reached that when the gall flows continuously instead of periodically into the intestine the absorption of nutrients is not affected.

Experiments with 2 other subjects are recorded. In these the urine was not collected. The experiments, therefore, could not be included in the present compilation.

Nos. 2011–2032 were made by Favitski in St. Petersburg in 1888. The object was to investigate the qualitative and quantitative metabolism of nitrogen in subjects with cirrhosis of the liver. The subjects were hospital patients suffering from this disease. The food usually consisted of a mixed diet. In several cases milk only was consumed.

Seven experiments are described. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The urea was usually estimated by the Borodin method after precipitating the extractives by phosphomolybdic acid (Thudicum's method). In Nos. 2013 and 2015 Byasson's method was employed. The uric acid was determined according to Ludwig's method.

The subject of No. 2021 was under observation only 8 days since symptoms of meningitis appeared, and the patient soon died from this disease. In Nos. 2011 and 2012 the cirrhosis was in the incipient stage, but was more advanced in all other cases. The subjects usually received no treatment at the beginning of the experiment. Later various therapeutic measures were tried, including the alkaline, milk, diuretic, and potassium iodid treatments and faradization. The effect of the different kinds of treatment is not discussed. The author sums up his results as follows:

In intensity, though not in quality, the metabolism of nitrogen in the subjects with cirrhosis of the liver approaches that of healthy persons on a mixed diet. The assimilation of nitrogen was from 84 to 94 per cent, and therefore about normal. The quantity of urea excreted during 24 hours varied within wide limits, namely from 14 to 45 grams; the usual quantity was 25 to 30 grams. The author remarks that his observations corroborate the opinion of Harley and of Labadie-Legran that the variations in the quantity of urea excreted are more dependent on the general nutrition than on the condition of the liver tissues.

In the excretion of uric acid wide variations were also observed. In most cases they were parallel with the variations of urea. The absolute amount of extractives in the urine was not large, and did not vary much from that in healthy man.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM DISEASES OF THE RESPIRATORY SYSTEM.

In Table 20 are included 27 tests with men in which the subjects were suffering from pneumonia. In these experiments special questions were studied, for instance, the effect of pneumonia on the metabolism and assimilation of nitrogen, or the effect of some particular treatment on the condition of the subject.

TABLE 20.—*Experiments with subjects with diseases of the respiratory system.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2033	1869	Huppert and Riesell.	Man (B.)	25	53.3	Mixed diet	4	0.7	15.8	0.8	—15.9	Pneumonia. High fever, 0.4 gm. nitrogen in sputa.
2034	1869	do	do	25	50.0	do	1	0.0	22.8	2.1	—24.9	First day of convalescence. 0.1 gm. nitrogen in sputa.
2035	1869	do	do	25	51.1	do	4	6.6	21.1	2.0	—16.5	Little fever. Four days following No. 2034, 0.1 gm. nitrogen in sputa.
2036	1869	do	do	25	50.0	do	15	23.3	19.8	4.5	— 1.0	No fever. Fifteen days following No. 2035. No nitrogen in sputa.
2037	1869	do	do	25	50.0	do	2	4.5	8.1	2.1	— 5.7	No fever. Two days following No. 2036.
2038	1869	do	Man (K.)	31	58.3	do	18	5.6	16.5	1.2	—12.1	Pneumonia. Fever. Nitrogen in sputa 0.5 gm. (mean of 11 days).
2039	1879	Röhmann	Man	43	......	Milk, coffee, bread	8	......	......	......	......	Pneumonia. NaCl in feces = average of 7 days. NaCl in food, 4.0 gm.; in urine, 4.3 gm.; in feces, 0.3 gm.; loss, 0.6 gm.
2040	1879	do		42	......	do	10	......	......	......	......	Pneumonia. NaCl in food, 5.0 gm.; in urine, 4.4 gm.; in feces, 0.1 gm.; gain 0.5 gm.
2041	1888	Abramovitch	Hospital servant	22	55.5	141.7 gm. bread, 1,067.8 gm. milk, 85 gm. blackberries (1 day), tea, blueberry jelly, and water.	2	8.1	17.2	1.3	—10.4	Croupous pneumonia. Before crisis.
2042	1888	do	do	22	55.0	227 gm. bread, 863 gm. milk, 223 gm. bouillon, 38 gm. egg.	2	10.0	15.7	1.5	— 7.2	Croupous pneumonia. After crisis.
2043	1888	do	do	22	54.5	555.6 gm. bread, 150.4 gm. meat, 134.1 gm. bouillon, 39 gm. egg (1 day), 654.5 gm. soup, tea, blueberry jelly, and water.	4	19.3	10.5	1.6	+ 7.2	Convalescence.
2044	1888	do	Laborer	42	63.0	138 gm. bread, 560 gm. milk, 134 gm. blackberries (1 day), tea, blueberry jelly, and water.	2	7.1	15.2	1.5	— 9.6	Croupous pneumonia. Before crisis. 0.1 gm. nitrogen in sputa.

2045	1888	.....do	Laborer	24	53.6	131 gm. bread, 838 gm. milk, 222 gm. soup, 106 gm. blackberries (1 day), tea, blueberry jelly, and water.	3	7.3	20.0	1.0	—13.7	Croupous pneumonia. Before crisis, 0.02 gm. nitrogen in sputa.
2046	1888	.....do	.....do	24	52.6	130 gm. bread, 1,035 gm. milk, 51 gm. meat (1 day), 93 gm. cutlet, tea, blueberry jelly, and water.	2	11.7	21.6	1.6	—11.5	Croupous pneumonia. After crisis, 0.1 gm. nitrogen in sputa.
2047	1888	.....do	.....do	24	52.6	427 gm. bread, 131 gm. meat, 39 gm. cutlet, 625 gm. soup, tea, blueberry jelly, and water.	5	17.5	13.1	2.4	+ 2.0	Croupous pneumonia. Convalescence, 0.05 gm. nitrogen in sputa.
2048	1888	.....do	Laborer	32	55.7	159 gm. bread, 104 gm. milk, 265 gm. bouillon, 79 gm. blackberries (1 day), tea, blueberry jelly, and water.	3	8.8	18.4	1.1	—10.7	Croupous pneumonia. Before crisis, 0.2 gm. nitrogen in sputa.
2049	1888	.....do	.....do	32	54.3	210 gm. bread, 1,091 gm. milk, 204 gm. bouillon, 63 gm. cutlet, tea, blueberry jelly, and water.	4	12.2	21.4	2.5	—11.7	Croupous pneumonia. After crisis. 0.4 gm. nitrogen in sputa.
2050	1888	.....do	.....do	32	53.8	473 gm. bread, 158 gm. meat, 82 gm. cutlet, tea, blueberry jelly, and water.	5	22.8	17.2	1.8	+ 3.8	Croupous pneumonia. Convalescence, 0.2 gm. nitrogen in sputa.
2051	1888	.....do	Laborer	23	64.8	47 gm. bread, 692 gm. milk, 177 gm. bouillon (1 day), 58 gm. blackberries (1 day), tea, blueberry jelly, and water.	2	5.2	20.9	0.9	—16.6	Croupous pneumonia. Before crisis, 0.2 gm. nitrogen in sputa.
2052	1888	.....do	.....do	23	62.7	104 gm. bread, 995 gm. milk, 118 gm. bouillon, 145 gm. meat (1 day), 155 gm. soup (1 day), tea, blueberry jelly, and water.	5	8.4	16.3	1.4	— 9.3	Croupous pneumonia. After crisis, 0.06 gm. nitrogen in sputa.
2053	1888	.....do	.....do	23	60.8	652 gm. bread, 107 gm. milk, 148 gm. meat, 808 gm. soup, tea, blueberry jelly, and water.	3	25.3	16.2	3.2	+ 5.9	Croupous pneumonia. Convalescence, 0.01 gm. nitrogen in sputa.
2054	1888	.....do	Laborer	23	63.2	42 gm. bread, 1,276 gm. milk, 73 gm. bouillon (1 day), 75 gm. blackberries (1 day), tea, blueberry jelly, and water.	5	7.9	21.2	2.3	—15.6	Croupous pneumonia. Before crisis subject took corrosive sublimate, 0.4 gm. nitrogen in sputa.
2055	1888	.....do	.....do	23	54.2	196 gm. bread, 1,068 gm. milk, 71 gm. bouillon, 481 gm. soup, tea, blueberry jelly, and water.	6	11.7	15.3	2.7	— 6.3	Croupous pneumonia. After crisis, 0.3 gm. nitrogen in sputa.
2056	1888	.....do	.....do	23	53.7	527 gm. bread, 564 gm. milk (1 day), 134 gm. meat, 92 gm. cutlet, 488 gm. soup, tea, blueberry jelly, and water.	3	21.7	14.3	2.1	+ 5.3	Croupous pneumonia. Convalescence, 0.1 gm. nitrogen in sputa.
2057	1888	.....do	Laborer	21	70.0	981 gm. milk, 170 gm. bouillon, 57 gm. blackberries (1 day), tea, blueberry jelly, and water.	4	5.0	22.7	1.2	—18.9	Croupous pneumonia. Before crisis subject took corrosive sublimate, 0.1 gm. nitrogen in sputa.
2058	1888	.....do	.....do	21	66.4	180 gm. bread, 1,031 gm. milk, 148 gm. bouillon, 60 gm. meat (1 day), 20 gm. cutlet, 62 gm. egg, tea, blueberry jelly, and water.	10	9.0	17.5	1.0	— 9.5	Croupous pneumonia. After crisis, 0.3 gm. nitrogen in sputa.
2059	1888	.....do	.....do	21	61.9	338 gm. bread, 1,563 gm. milk, 229 gm. bouillon, 150 gm. meat, 89 gm. cutlet, 62 gm. egg, tea, blueberry jelly, and water.	2	23.9	14.5	3.5	+ 5.9	Croupous pneumonia. Convalescence, 0.0 gm. nitrogen in sputa.

Nos. 2033–2038. Arch. Heilkunde, 1869, pp. 331, 332. Nos. 2039, 2040. Ztschr. Klin. Med., 1, pp. 529, 530. Nos. 2041–2043. Nitrogen metabolism of patients with croupous pneumonia. Inaug. Diss. (Russian), St. Petersburg, 1888. Table 1. No. 2044. Ibid., Table 2. Nos. 2045–2047. Ibid., Table 3. Nos. 2048–2050. Ibid., Table 4. Nos. 2051–2053. Ibid., Table 5. Nos. 2054–2056. Ibid., Table 6. Nos. 2057–2059. Ibid., Table 7.

Nos. 2033–2038 were made by Huppert and Riesell in the Jacobs Hospital in Leipsic (?) in 1868–69. The object was to investigate the effect of fever (body temperature higher than normal) on metabolism. According to the observer, these are the first experiments of the kind. The subject in Nos. 2033–2037 was a man suffering with croupous pneumonia. The experiment includes three periods, namely, high fever, little fever, and convalescence with no fever. The subject in No. 2038 was a man suffering from pneumonia following typhoid fever. During the whole experiment the man had fever, and his death occurred on the day after the experiment ended. The food was evidently a mixed diet, though the details of its composition are not given. The nitrogen was determined in each article whenever a fresh supply was procured. The nitrogen in the urine, and probably in the feces also, was determined by the Seegen-Schneider method.

The experiments are not described by the author with much detail. The principal conclusions drawn were the following: A man with fever uses more protein from the organism than a fasting man.

A healthy individual can metabolize as much protein as a man with fever, but in the first case it is protein which is stored up in the body and in the second it is protein of the tissues. A man with fever requires nonnitrogenous nutrients as well as protein

One of the investigators, Huppert, made further experiments with two subject, having febris recurrens. One (H.) was 18 years old and the other (E.) 22 years old. They weighed 60 kg. and 58 kg., respectively, at the beginning of the experiment. The food consisted of a mixed diet, H. consuming about twice as much protein as E.

The experiment with H. lasted 22 days. The author determined the income and outgo of nitrogen for each day. From the fifth to the fifteenth day the temperature of the subject ranged from 37½° to 40° C. On the other days it was normal. The average amount of nitrogen consumed per day before, during, and after the fever period was 22.8, 19.7, and 22.3 gm., respectively. The average amount of nitrogen excreted daily in the urine for the corresponding periods was 17.3, 18.6, and 15 gm. and that excreted in the feces was 3.5, 2.0, and 2.1 gm. There was an average daily gain of 2.0 gm. and 5.2 gm. of nitrogen in the first and third periods, and an average loss of 0.9 gm. in the second or fever period.

The experiment with E. covered 19 days. From the fourth to the eleventh day his temperature ranged from 37° to 40.2° C. The income and outgo of nitrogen was determined as above. The average amount of nitrogen consumed per day before, during, and after the fever period was 8.6, 9.1, and 9.5 gm., respectively. The average amount excreted in the urine for the corresponding periods was 15.9, 15.3, and 11.9 gm.; and that excreted in the feces was 1.6, 1.2, and 0.6 gm. The average daily loss of nitrogen during the three periods was 8.9, 7.4, and 3.0 gm., respectively.

In the author's opinion, the results indicate either that the protein of tissue (*Organeiweiss*) is changed into reserve protein (*Vorrathseiweiss*), or that the protein of tissue is broken up into a complex radicle containing nitrogen and a nitrogen-free substance, which is probably burned in the body. The latter alternative is regarded as the more probable. The experiments are discussed at some length from a medical standpoint.

These experiments were omitted from the tables by an oversight.

Nos. 2039, 2040 were made by Röhmann at the Medical Institute of the University of Berlin in 1877–78, and form a series with Nos. 1487, Table 17, and 1858, Table 18. The object was to study the excretion of sodium chlorid during fever—that is, when the body temperature was higher than normal. The subjects of Nos. 2039 and 2040 were men suffering from pneumonia. The subject of No. 1858 had rheumatism. The experimental details were the same as those previously noted.

In addition to these tests the author reported several others, in which the details for metabolic balance were not complete. A workman (P.), 26 years old, with pneumonia consumed daily on an average on 4 days during which he had fever 5.2 grams of sodium chlorid and excreted 7.4 grams in the urine. During the period after his temperature became normal he consumed and excreted the same average quantities of sodium chlorid. The quantities consumed and excreted per day, however, varied within somewhat wide limits.

The author reports nothing concerning the amount and composition of the feces.

A locksmith (M.), 24 years old, with typhus exanthematicus during 4 days of fever consumed daily on an average 4.0 grams of nitrogen and 1.7 grams of salt. He excreted in the urine 11.3 grams of nitrogen and 1.6 grams of salt. No feces were excreted during the test.

A test was also made with a mason (A.), 19 years old, with morbilli (measles). The food consisted of milk, eggs, bread, and raw meat. Its composition is not recorded. During 3 days of fever the subject excreted daily on an average 4.9 grams of sodium chlorid in the urine and 0.2 gram in the feces. On one day after the temperature became normal he excreted 10.7 grams sodium chlorid in the urine and 0.2 gram in the feces.

From these experiments and those previously noted the author drew the conclusion that in acute fever the chlorids consumed are not excreted in normal quantity in the urine. The retention of sodium chlorid is regarded as due to the changes in general metabolism caused by the increased body temperature.

Nos. 2041–2059 were made by Abramovitch in St. Petersburg in 1888. The object was to investigate the metabolism of nitrogen in subjects with croupous pneumonia

Seven experiments are described. Each experiment, except Nos. 2043 and 2044, the subject of which died in the period of fever, was divided into three periods—the first before the crisis, the second immediately after the crisis, and the third during convalescence. During the period of fever 2 of the subjects were given antifebrin, 3 were given corrosive sublimate, while 2 received no special medicine.

The food of the subjects was the ordinary hospital diet, and usually consisted of half-white bread, milk, and sometimes a little bouillon, if desired. During the fever period and for 3 days after the crisis 5 tablespoonfuls of sherry wine were also allowed daily. During convalescence the diet was more abundant. The separation of the feces was made with blackberries. The nitrogen of the food, urine, etc., was determined by the Kjeldahl-Borodin method. The nitrogen of the antifebrin was estimated in the same way. Albumen was found in the urine of all the patients during the period of fever and of the majority of them for some days after the crisis. This had to be removed from the urine before determining the urea and the uric acid. The nitrogen of the sputa was also determined.

The author draws the following conclusions: The assimilation of the nitrogenous constituents of the food in the fever period was in all cases poorer than during the time of convalescence. In the fever period and during 2 or more days after the crisis an intensified destruction of the protein of the tissues took place. During the time of convalescence, when the patients began to take sufficient food, a part of the nitrogen of the food was retained. The increased outgo of nitrogen in the urine in the period immediately after the crisis may be chiefly accounted for by the intensified destruction of protein tissue. The ratio of the extractives to uric acid and urea was higher than normal in all cases in the fever period, and in the majority of cases during convalescence. The cleavage of protein of the tissues was greatest in patients treated with corrosive sublimate, and least in those treated with antifebrin. The ratio of the extractives to uric acid and urea was less in the former case.

So far as was observed, the treatment with corrosive sublimate had no influence on the amount of albumen in the urine.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM DISEASES OF THE CIRCULATORY SYSTEM.

In Table 21 are included 8 tests with men, 31 with women, and 2 with children, in which the subjects were suffering from some form of heart disease. In each case special questions were studied; for instance, the effect of heart disease on the metabolism and assimilation of nitrogen, or the effect of some particular treatment on the condition of the subject.

TABLE 21.—*Experiments with subjects with diseases of the circulatory system.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2060	1888	Dashkevich	Retired soldier	59	70.0	Bread, cutlet, manna, milk, oatmeal, blackberries, 500 cc. tea.	11	23.4	20.8	2.6	0.0	Insufficientia valv. mitralis. Subject was given tinctura strophanthi.
2061	1888	....do	....do	59	66.7	....do	3	28.7	22.8	3.8	+2.1	Insufficientia valv. mitralis.
2062	1888	....do	....do	59	67.0	Bread, cutlet, meat, manna, soup, oatmeal, blackberries, 750 cc. tea.	7	27.1	18.4	3.9	+4.8	Insufficientia valv. mitralis. Tepid Neuheim baths.
2063	1888	....do	....do	59	73.0	....do	5	23.1	19.6	3.4	+0.1	Insufficientia valv. mitralis. Subject was given digitalis.
2064	1888	....do	Retired soldier	42	62.2	Bread, meat, cutlet, soup, blackberries, 750 cc. tea, 650–790 cc. milk.	3	23.0	14.9	2.7	+5.4	Insufficientia valv. aortæ et mitralis.
2065	1888	....do	....do	42	61.0	....do	5	24.5	19.7	3.4	+1.4	Insufficientia valv. aortæ et mitralis. Subject was given digitalis.
2066	1888	....do	....do	42	61.4	....do	9	25.4	23.2	2.9	—0.7	Insufficientia valv. aortæ et mitralis. Tepid baths.
2067	1888	....do	Peasant woman	36	48.8	Bread, white bread, 1,000–3,000 cc. milk, cutlet, blackberries, 4,500 cc. tea.	3	17.2	10.8	2.8	+3.6	Stenosis ostei ven. sin. c. insufficientia valv. mitralis.
2068	1888	....do	....do	36	51.0	Bread, white bread, cutlet, blackberries, meat, 450 cc. tea.	7	20.7	10.2	2.8	+7.7	Stenosis ostei ven. sin. c. insufficientia. Subject was given tinctura strophanthi.
2069	1888	....do	....do	36	53.8	....do	7	17.3	11.1	2.3	+3.9	Stenosis ostei ven. sin. c. insufficientia. Subject was given digitalis.
2070	1888	....do	Peasant woman	35	53.0	Bread, cutlet, 450–1,000 cc. milk, bouillon, blackberries, 240 cc. tea.	3	13.8	8.8	1.8	+3.2	Stenosis ostei ven. sin. c. insufficientia.
2071	1888	....do	....do	35	54.0	....do	5	11.6	8.4	2.2	+1.0	Stenosis ostei ven. sin. c. insufficientia. Subject was given digitalis.
2072	1888	....do	....do	35	56.0	Bread, 450–1,000 cc. milk, bouillon (1 day), blackberries, 240 cc. tea.	6	5.1	6.7	1.6	—3.2	Stenosis ostei ven. sin. c. insufficientia. Subject was given caffeinum natro-salicylium and digitalis last day.

2073	1888	.....do	Peasant woman.....	42	52.6	Bread, meat, cutlet, soup, blackberries, 800 cc. tea.	3	15.8	10.7	2.0	+3.1	Insufficientia valv. mitralis.
2074	1888	.....do	.....do	42	51.0	.....do	18	16.8	12.5	1.8	+2.5	Insufficientia valv. mitralis. Tepid baths.
2075	1888	Grassmann	Woman.............	43	....	790 gm. milk, 104 gm. white bread, 14.2 gm. butter, 77.1 gm. egg, 1.3 gm. salt (29.1 gm. fat).	7	6.9	5.6	0.8	+0.5	Heart disease.
2076	1888	.....do	Woman.............	29	....	1,500 gm. milk, 20.8 gm. meat, 64.5 gm. egg, 31.3 gm. butter, 136.9 gm. white bread, 1.2 gm. salt (48.8 gm. fat).	4	11.4	10.7	1.2	—0.5	Do.
2077	1888	.....do	Woman.............	39	....	1,831.7 gm. milk, 192.5 gm. white bread (22.9 gm. fat).	3	12.2	10.6	2.3	—0.7	Do.
2078	1888	.....do	Man	40	....	1,958.8 gm. milk, 136.1 gm. white bread (24.4 gm. fat).	4	12.1	14.7	1.6	—4.2	Do.
2079	1888	.....do	Woman.............	41	....	1,733.3 gm. milk, 67.5 gm. meat, 27.8 gm. egg, 31.9 gm. butter, 140.8 gm. white bread, 2.3 gm. salt, a little onion and pepper (55.2 gm. fat).	3	13.6	9.8	1.4	+2.4	Do.
2080	1888	.....do	Woman.............	29	....	933.8 gm. milk, 139.5 gm. white bread, 34 gm. butter, 56.5 gm. meat, 1.9 gm. salt (54.2 gm. fat).	3	13.3	8.0	1.0	+4.3	Do.
2081	1894	Schneider.........	Woman (M.)	43	....	Meat, butter, soup, etc. (65.8 gm. fat, 139.0 gm. carbohydrates, 2,671 gm. water, 1,480 calories).	11	7.6	6.6	1.0	0.0	Valvular heart disease.
2082	1894	.....do	Woman (G.)........	59	....	Milk, sausage, white bread, potatoes, butter, coffee (87.1 gm. fat, 231.6 gm. carbohydrates, 1,806 gm. water, 2,167 calories).	17	15.0	10.1	1.2	+3.7	Do.
2083	1894	.....do	Woman (Z.)........	28	....	Milk, white bread, coffee, wine, grapes (29.1 gm. fat, 69.7 gm. carbohydrates, 918 gm. water, 702 calories).	11	5.9	8.0		—2.1	Valvular heart disease. Nitrogen in excreta includes 1.0 gm. from pus.
2084	1894	.....do	.....do	28	....	Milk, white bread, sausage, butter, seltzer (72.8 gm. fat, 137.2 gm. carbohydrates, 1,468 calories).	5	8.9	7.0	1.4	+0.5	Valvular heart disease.
2085	1894	Husche	Woman (L.)........	43	56.1	1,000 gm. milk, eggs, butter, wine, black bread, water (56.4 gm. fat, 79.1 gm. carbohydrates, 7.6 gm. alcohol, 1,605 gm. water, 1,097 calories).	6	7.5	8.7	0.3	—1.5	Heart disease.
2086	1894	.....do	.....do	43	56.1	Milk, eggs, butter, wine, etc. (56.6 gm. fat, 76.6 gm. carbohydrates, 7.6 gm. alcohol, 1,605 gm. water, 1,105 calories).	4	7.9	6.9	0.7	+0.3	Do.
2087	1894	.....do	.....do	43	56.1	Milk, eggs, bread, butter, meat, etc. (71.0 gm. fat, 83.2 gm. carbohydrates, 7.6 gm. alcohol, 1,283 gm. water, 856 calories).	13	6.1	7.6	0.8	—2.3	Do.
2088	1894	.....do	.....do	43	56.1	Milk, eggs, bread, butter, meat, etc. (30.8 gm. fat, 136.2 gm. carbohydrates, 7.6 gm. alcohol, 1,518 gm. water, 1,165 calories).	8	4.6	5.1	0.5	—1.0	Do.
2089	1894	.....do	Woman.............	19	....	Milk, eggs, bread, butter, meat, etc. (68.9 gm. fat, 241.4 gm. carbohydrates, 3.8 gm. alcohol, 137.1 gm. water, 1,838 calories).	9	8.2	6.7	1.5	0.0	Do.
2090	1894	.....do	Girl (H.)	16	....	Milk, eggs, butter, meat, etc. (79.3 gm. fat, 229.8 gm. carbohydrates, 7.6 gm. alcohol, 2,094 gm. water, 2,097 calories).	8	14.5	8.9	2.1	+2.5	Do.

TABLE 21.—*Experiments with subjects with diseases of the circulatory system*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2091	1894	Husche	Girl (H.)	16	......	Milk, eggs, butter, meat, etc. (75.5 gm. fat, 232.0 gm. carbohydrates, 7.6 gm. alcohol, 2,862 gm. water, 2,057 calories).	3	15.3	6.6	1.6	+7.1	Heart disease.
2092	1894	.....do	Woman (K.)	41	......	Milk. eggs, meat, etc. (85.7 gm. fat, 231.8 gm. carbohydrates, 7.6 gm. alcobol (6 days only), 3,206 gm. water, 2,106 calories).	7	12.6	11.6	0.7	+0.3	Do.
2093	1894	.....do	Woman (F.)	47	......	Milk, eggs, meat, etc. (26.9 gm. fat, 69.9 gm. carbohydrates, 7.6 gm. alcohol (3 days only), 1,275 gm. water. 650 calories).	8	3.9	7.1	0.5	—3.7	Do.
2094	1894	.....do	Woman (H.)	73	......	Meat, bread, milk, etc. (12.5 gm. fat, 41.7 gm. carbohydrates, 5.5 gm. alcohol (6 days only), 1,111 gm. water, 365 calories).	15	2.1	4.7	0.2	—2.8	Do.
2095	1894	.....do	Woman (M.)	43	......	Meat. butter, bread, etc. (34.5 gm. fat, 91.5 gm. carbohydrates, 11.9 gm. alcohol, 1,446 gm. water, 854 calories).	17	3.6	6.3	0.4	—3.1	Do.

Nos. 2060, 2061. The metabolism of nitrogen in patients with heart disease during the period of deranged compensation. Inaug. Diss. (Russian), St. Petersburg, 1888, p. 28. Nos. 2062, 2063. Ibid., pp. 30, 31. Nos. 2064, 2065. Ibid., p. 34. Nos. 2066–2069. Ibid., p. 38. Nos. 2070–2072. Ibid., p. 42. Nos. 2073, 2074. Ibid., p. 48. No. 2075. Ztschr. klin. Med., 15, p. 187. No. 2076. Ibid., p. 190. No. 2077. Ibid., p. 194. No. 2078. Ibid., p. 197. No. 2079. Ibid., p. 200. No. 2080. Ibid., p. 203. No. 2081. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 3, p. 57. No. 2082. Ibid., p. 62. No. 2083. Ibid., p. 68. No. 2084. Ibid., p. 72. Nos. 2085, 2086. Ibid., p. 23. No. 2087. Ibid., p. 25. Nos. 2088, 2089. Ibid., pp. 27, 28. Nos. 2090, 2091. Ibid., p. 30. No. 2092. Ibid., p. 32. No. 2093. Ibid., p. 34. No. 2094. Ibid., p. 36. No. 2095. Ibid., p. 39.

Nos. 2060–2074 were made by Dashkevich in St. Petersburg in 1888. The object was to study the metabolism of nitrogen in subjects with heart disease in the period of deranged compensation. Five experiments are described. All the subjects were more or less seriously afflicted with heart disease. Each experiment was divided into two or three periods. In one period the subjects received no special treatment. In the other periods they were given the usual treatment which their symptoms seemed to demand, either tincture of strophanthus, digitalis, caffeinum natro-salicylium, or tepid Nauheim baths. The food consisted of bread, meat, milk, etc. The separation of the feces was made with blackberries. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method, and the nitrogen of the urea by Borodin's method, having first removed the extractives by Byasson's method. The uric acid was determined in the first 4 experiments by the Haycraft-Ludwig method and in the fifth experiment by Haycraft's method.

The following conclusions were reached: In the periods with no special medical treatment the metabolism of nitrogen decreased and the ratio of the nitrogen of the extractives to that of the urea (1:14) was larger than normal.

When digitalis was given the metabolism increased in every case, i. e., the excretion of the cleavage products of protein was increased. This may perhaps explain the favorable action of digitalis on patients with heart disease.

The changes in metabolism due to tincture of strophanthus were contradictory.

No conclusions can be drawn regarding the effect of caffeinum natro-salicylium, which was administered in only one case.

The influence of the tepid artificial Nauheim baths on metabolism varied in different cases, though on the whole the subjects were benefited. The author believes that these baths are permissible in heart diseases, though not in severe cases.

Nos. 2075–2080 were made by Grassmann at the Charité Hospital in Berlin in 1886–87 to investigate the assimilation of food by subjects with disturbed circulation. The subjects were hospital patients, 5 women and a man, who were suffering from heart disease, which caused such disturbance of the circulation. The food consisted of milk and white bread, and in some cases butter, meat, and eggs were also consumed. The nitrogen and fat in the milk, the nitrogen and chlorin in the urine, and the nitrogen, fat, and fatty acids in the feces were determined. The composition of the meat and eggs was calculated from Voit's figures and the bread from Müller's. The separation of the feces was made with charcoal. Starch grains were not found in the feces. The author therefore concludes that the absorption of carbohydrates was not disturbed. The assimilation of nitrogen differed very little from the normal. The assimilation of fat was diminished.

Nos. 2081–2084 were made by Schneider at the Charité Hospital in Berlin in 1893–94. The object was to investigate the nitrogen balance of persons with valvular disease of the heart. The subjects were 3 women suffering from this disease. The food consisted of a simple mixed diet. The composition of several articles—for instance, milk, cocoa, sausage, and potato—was determined. The composition of meat, bread, soup, and butter was calculated from analyses made by von Noorden, and the composition of eggs from Voit's figures. The separation of the feces was made with charcoal. The nitrogen in the urine and feces and the fat in the feces were determined.

The conclusion is reached that there is no typical relation of the nitrogen balance to disease of the heart. The changes in the individual experiments are discussed at length.

Nos. 2085–2095 were made by Husche at the Charité Hospital in Berlin in 1892–93 to study the nitrogen balance in various stages of heart disease. The subjects were women suffering from some form of heart disease. The food consisted of a simple mixed diet of milk, meat, eggs, etc. The nitrogen in the milk was usually determined. The nitrogen, fat, and carbohydrates in the porridge, veal, and sausage were determined. The composition of other articles of food was calculated from von Noorden's and from König's figures. The urine and feces were analyzed.

The following conclusions were reached: Disease of the heart affects the amount of urine excreted. The increase or decrease of the amount of nitrogen eliminated varies in the same way as the amount of urine, though the two are not parallel. The variations in the nitrogen balance take place more quickly than the variations in the quantity of urine. The excretion of nitrogen and fat in the feces and the relative amounts of different nitrogenous compounds in the urine were also investigated. The article contains much matter interesting from a medical standpoint.

The author, with Vogel and von Noorden,[1] made further investigations on the effect of heart disease on the excretion of urine and nitrogen. The following deductions were drawn: When treatment with digitalis is successful the amount of urine is greatly increased and large quantities of nitrogen are removed from the body. Very abundant excretion of nitrogen seldom continues more than 2 to 4 days. In the experiments made the nitrogen excretion in the urine exceeded that consumed in the food by 10 to 15 grams daily. The increased nitrogen excretion was not always regular from day to day, though the diuresis was constant. Sometimes it was found that the urine excretion was greatly increased, while the excretion of nitrogen was unaffected. Von Noorden is of the opinion that when the excretion of nitrogen is increased the nitrogen which was stored up in anasarcous tissue is removed from the body.

These conclusions are in accord with those of Kobler,[2] who studied the effect on the excretion of nitrogen and urine of treating heart disease with digitalis. The proportion of different nitrogenous constituents in the urine was also studied. Experiments were made with 7 subjects, men and women who were hospital patients suffering from some form of heart disease which caused deranged compensation. In every case the diet remained the same throughout the test. In one instance digitalis increased the daily excretion of urine from about 400 to 1,100 cubic centimeters. The excretion of urea was increased from 9.01 to 23.43 grams and the uric acid from 0.53 to 0.98 gram. In another test the urine was increased from 500 to 2,200 cubic centimeters, while the urea excretion was little affected, being increased from 10.9 to 15.6 grams. In the corresponding period the daily excretion of uric acid was increased from 0.29 to 0.40 gram. In another case the amount of urine was not much increased (from 320 to 700 cubic centimeters), while in the corresponding period the urea was increased from 8.64 to 21.42 grams.

The author was of the opinion that in the period of deranged compensation the excretion of urine and nitrogen was diminished. Proper treatment, for instance digitalis, in general caused an increased excretion of both urine and urea.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM DISEASES OF THE BLOOD AND DUCTLESS GLANDS.

In Table 22 are included 1 test with a man and 3 with women suffering from leucæmia or from chlorosis. In these experiments special questions were investigated. In one instance the effect of inhalation of oxygen gas was studied. Other experiments on the effect of varying oxygen content in respired air will be found on page 179. Tests were also made with a subject affected with leucæmia in which the special point studied was the influence of the remedial agent employed (Table 9, Nos. 795–799). Experiments with dogs in which anæmia was artificially produced will be found in Table 29, Nos. 2912–2917.

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[1] Lehrbuch der Pathologie des Stoffwechsels, p. 326.

[2] Wiener klin. Wochenschr., 4 (1891), p. 375.

TABLE 22.—*Experiments with subjects with diseases of the blood and ductless glands.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2096	1889	Burzhinski	Man	31	......	Bread, meat, rice, bouillon, and milk	6	9.5	9.7	1.1	—1.3	Leucæmia.
2097	1889	.....do	.....do	31	......	.....do	6	9.9	9.5	1.1	—0.7	Leucæmia. Inhalations of oxygen.
2098	1890	Ketcher	Teacher (Woman)	23	......	210 gm. bread, 252 gm. cutlet, 226 gm. bouillon, 575 gm. milk, 1,290 cc. tea.	8	15.9	13.0	0.8	+2.1	Chlorosis.
2099	1892	Lipman-Wulf	Woman (B.)	17	50.5	900 gm. milk, 90 gm. meat, 81 gm. egg, 209 gm. white bread, 60 gm. butter, 500 gm. soup, 300 gm. beer, 300 gm. coffee.	7	12.9	11.4	1.0	+0.5	Do.
2100	1892	.....do	.....do	17	50.5	1,500 gm. milk, 90 gm. meat, 79 gm. egg, 209 gm. white bread, 60 gm. butter, 500 gm. soup, 300 gm. beer, 300 gm. coffee.	1	15.1	13.9	1.0	+0.2	First day of No. 2099.
2101	1892	.....do	.....do	17	50.5	Food practically same as No. 2099	6	12.5	11.5	1.0	0.0	Last 6 days of No. 2099.
2102	1892	.....do	Woman (L.)	17	......	1,000 gm. milk, 279 gm. white bread, 80 gm. butter, 600 gm. soup, 600 gm. coffee, 71 gm. egg, 150 gm. wine, 100 gm. meat.	7	13.1	11.8	0.8	+0.5	Chlorosis.
2103	1892	.....do	Woman (L.)	20	......	1,000 gm. milk, 100 gm. meat, 279 gm. white bread, 80 gm. butter, 600 gm. soup, 600 gm. coffee, 150 gm. wine.	9	12.9	11.1	1.1	+0.7	Do.
2104	1893	Spirig	Man	46	......	500 gm. bread, 80 gm. butter, 70 gm. cheese, 60 gm. sausage, 165 gm. meat, 1,000 gm. coffee, 250 gm. soup, 100 gm. beer, 500 gm. seltzer water.	3	15.3	9.4	1.9	+4.0	Leucæmia.

Nos. 2096, 2097. Vrach, 10, p. 994. No. 2098. Ibid., 11, p. 1042. Nos. 2099-2101. Beiträge zur Lehre vom Stoffwechsel des gesunden und kranken Menschen, pt. 1, p. 32. No. 2102. Ibid., p. 34. No. 2103. Ibid., p. 38. No. 2104. Ibid., pt. 2, p. 152.

Nos. 2096 and 2097 were made by Burzhinski in St. Petersburg in 1889. The object was to study the influence of inhaling increased amounts of oxygen on the metabolism of nitrogen in subjects with leucæmia.

The subject was a man of middle stature and well built. He was suffering from leucæmia. The experiment lasted 12 days. The first 6 days were under usual conditions. During the last 6 days the subject inhaled 60 liters of oxygen per day. The inhalations were at 1 p. m. and at 6 p. m. The nitrogen in the food, urine, and feces was determined by the Kjeldahl method, the uric acid of the urine by the Ludwig method, and ammonia by Schlösing's method. The extractives of the urine were precipitated with phospho-tungstic acid.

The following conclusions were drawn: The metabolism of nitrogen and the quantity of uric acid, especially in relation to the urea, was increased in the subject with leucæmia when oxygen was inhaled.

No. 2098 was made by Ketcher in St. Petersburg in 1890 to investigate the metabolism of nitrogen in chlorosis. The subject was a woman teacher. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method.

The following are the author's conclusions: The assimilation of nitrogen in chlorosis was normal. The metabolism of nitrogen was 86.32 per cent—i. e., somewhat lower than the mean for healthy persons, but still not below the normal limits.

The total quantity of nitrogen, the nitrogen of urea, and the amount of chlorids and phosphates in the urine was less than normal.

The absolute amount of extractives in the urine was greater than normal.

Nos. 2099–2103 were made by Lipman-Wulf in Berlin in 1891. The object was to investigate the influence of chlorosis upon metabolism. The subjects were 3 young women suffering from this disease who were under treatment at the Charité Hospital. The investigations were not made until the patients had been in the hospital some days. The details of their condition are given in full by the author. The food consisted of milk, meat, bread, butter, eggs, soup, beer, wine, and coffee. Analyses of food, urine, and feces were made. The assimilation of nitrogen was very good, and the conclusion is drawn that chlorosis is not a disease which brings about a pathological change in the metabolism of protein. In these cases the metabolism was very much like that of a normal individual. In the diet fat and carbohydrates were present in abundance, but the amounts were not great enough to produce any abnormal effect in the way of protecting protein.

No. 2104 was made by Spirig in 1893 at the Charité Hospital in Berlin. The object was to study the assimilation of food in leucæmia. The subject was suffering from this disease. The blood contained 1,700,000 red and 137,500 white corpuscles per cubic millimeter when the subject was admitted to the hospital.

A simple mixed diet was consumed, consisting of bread, butter, cheese, sausage, meat, etc. The nitrogen, fat, and carbohydrates in the food were determined, also the nitrogen in the urine, and the nitrogen and fat in the feces. The assimilation of nitrogen and fat was not quite so good as in the case of a healthy individual. The organism gained nitrogen, which is in accord with von Noorden's theory that leucæmia is not a toxigenic protoplasm disturbing disease.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM DISEASES OF THE KIDNEYS.

In Table 23 are included 97 tests with men, 6 with women, and 5 with children, in which the subjects were suffering from nephritis, albumenuria, Bright's disease, amyloid diseases, or contracted kidney. In these experiments special questions were investigated—for instance, the effect of the disease on the metabolism and assimilation of nitrogen, or the effect of some particular treatment on the condition of the subject.

TABLE 23.—*Experiments with subjects with diseases of the kidneys.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2105	1886	Korkonnov	Man (V.)		69	2,535 cc. milk	4	23.4	19.6	1.7	+ 2.1	Chronic nephritis.
2106	1886	do	do		65	4,570 cc. milk	3	27.0	20.5	1.5	+ 5.0	Chronic nephritis. Baths.
2107	1886	do	Man (V.)		67	3,933 cc. milk	3	24.4	20.3	1.5	+ 2.6	Chronic nephritis.
2108	1886	do	do		65	5,000 cc. milk	3	31.5	19.2	1.5	+10.8	Chronic nephritis. Baths.
2109	1886	do	Man (B.)		76	2,843 cc. milk	3	13.3	13.3	13.1	—13.1	Chronic nephritis.
2110	1886	do	do		68	3,500 cc. milk	5	18.1	13.6	10.2	— 5.7	Chronic nephritis. Baths.
2111	1886	do	do			do	3	18.5	13.9	10.4	— 5.8	Last 3 days of No. 2110.
2112	1886	do	Man (V.)		65	3,780 cc. milk	5	20.0	16.4	2.9	+ 0.7	Nitrogen in feces=average of 3 days.
2113	1886	do	do			3,700 cc. milk	3	20.0	15.4	2.9	+ 1.7	Last 3 days of No. 2112.
2114	1886	do	do		62	4,200 cc. milk	4	22.2	16.5	3.1	+ 2.6	
2115	1888	Grigoriev	Soldier	22	64	368 gm. half white bread, 254 gm. oatmeal, 402 gm. soup (1 day), 58 gm. cutlet.	3	13.5	13.3	0.6	— 0.4	Nephritis parenchymatosa acuta toxica.
2116	1888	do	do	22	58	51.2 gm. half white bread (1 day), 1,751 gm. milk, 103 gm. blackberries (1 day), 112 gm. water (1 day).	7	8.3	14.5	0.7	— 6.9	Do.
2117	1888	do	do	22	50	290 gm. half white bread, 166 gm. oatmeal, 311 gm. soup (1 day), 90 gm. meat, 68 gm. cutlet, 349 gm. tea.	3	14.0	12.8	0.5	+ 0.7	Nephritis parenchymatosa acuta toxica. Warm baths.
2118	1888	do	Cabman	51	81	57.5 gm. half white bread (1 day), 1,826 gm. milk, 93 gm. blackberries (1 day).	5	9.3	8.0	0.3	+ 1.0	Nephritis parenchymatosa chronica.
2119	1888	do	do	51	78	48 gm. half white bread, 1,222 gm. milk	4	7.2	9.9	0.2	— 2.9	Do.
2120	1888	do	Blacksmith	27	79	52 gm. white bread (1 day), 220 gm. bouillon (1 day), 1,757 gm. milk, 1,250 gm. water.	4	9.0	11.9	2.5	— 5.4	Do.
2121	1888	do	do	27	80	162 gm. bread (1 day), 222 gm. bouillon (1 day), 1,284 gm. milk, 78 gm. jam, 902 gm. tea, 955 gm. water.	3	6.6	10.0	3.2	— 6.6	Do.
2122	1888	do	do	27	80	100.5 gm. bread (1 day), 162 gm. white bread, 65 gm. crackers (1 day), 91 gm. cutlet, 1,142 gm. milk, 902 gm. tea, 744 gm. water.	3	11.5	8.2	6.3	— 3.0	Do.
2123	1888	do	do	27	81	98 gm. white bread, 92 gm. cutlet, 1,143 gm. milk, 1,148 gm. tea, 955 gm. water.	3	10.4	8.6	7.1	— 5.3	Do.
2124	1888	do	do	27	85	143 gm. white bread, 97 gm. cutlet, 1,090 gm. milk, 738 gm. tea, 716 gm. water, 138 gm. blackberries, 50 gm. roasted meat (1 day).	3	11.1	14.5	3.2	— 6.6	Nephritis parenchymatosa chronica. Subject was given digitalis.

TABLE 23.—*Experiments with subjects with diseases of the kidneys*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2125	1888	Grigoriev........	Blacksmith........	27	87	153 gm. white bread, 434 gm. oatmeal, 103 gm. boiled meat, 56 gm. roasted meat, 967 gm. milk, 984 gm. tea, 716 gm. water.	3	14.8	10.7	7.9	—3.8	Nephritis parenchymatosa chronica.
2126	1888	.....do	.....do	27	88	142 gm. bread (1 day), 129 gm. white bread, 340 gm. oatmeal, 119 gm. boiled meat, 101 gm. cutlet, 60 gm. roast veal, 1,280 gm. milk, 67 gm. jam, 187 gm. blackberries, 984 gm. tea, 716 gm. water.	4	17.8	10.4	5.7	+1.7	Do.
2127	1888	.....do	.....do	27	89	325 gm. bread (1 day), 82 gm. white bread, 2,001 gm. milk, 29 gm. jam, 163 gm. blackberries, 984 gm. tea.	5	12.9	13.2	3.6	—3.9	Do.
2128	1888	.....do	.....do	27	90	719 gm. white bread, 2,266 gm. milk, 984 gm. tea.	3	13.8	11.0	6.6	—3.8	Do.
2129	1888	.....do	.....do	27	90	74 gm. white bread, 2,043 gm. milk, 984 gm. tea.	1	11.4	9.4	5.3	—3.3	Do.
2130	1888	.....do	.....do	27	91	133 gm. white bread, 1,365 gm. milk, 984 gm. tea.	5	9.2	9.4	4.8	—5.0	Nephritis parenchymatosa chronica. Subject was given jaborandi.
2131	1888	.....do	.....do	27	92	153 gm. white bread, 1,053 gm. milk, 984 gm. tea, 191 gm. blackberries.	3	8.0	8.3	4.7	—5.0	Nephritis parenchymatosa chronica. Subject was given pilocarpin.
2132	1888	.....do	Laborer..........	25	62	354 gm. half white bread, 250 gm. white bread (1 day), 335 gm. soup (1 day), 109 gm. boiled meat, 86 gm. cutlet, 925 gm. manna gruel (1 day), 152 gm. sausage (1 day), 1,461 gm. tea, 283 gm. water.	5	16.1	16.8	3.4	—4.1	Nephritis diffusa chronica.
2133	1888	.....do	.....do	25	58	163 gm. half white bread, 78 gm. white bread, 470 gm. soup (2 days), 71 gm. boiled meat, 80 gm. roasted meat (1 day), 515 gm. manna (2 days), 310 gm. cakes (1 day), 1,177 gm. tea, 358 gm. water.	10	11.1	12.6	2.4	—3.9	Nephritis parenchymatosa chronica. Subject was given strophanthus.
2134	1888	.....do	.....do	25	56	250 gm. half white bread, 1,339 gm. milk, 1,230 gm. water, 374 gm. tea.	7	11.4	12.0	2.3	—2.9	Nephritis parenchymatosa chronica.
2135	1888	.....do	.....do	25	57	236 gm. half white bread, 57 gm. white bread, 1,488 gm. milk, 1,381 gm. tea, 363 gm. water.	3	13.5	15.0	1.0	—2.5	Do.

2136	1888	.....do	Policeman	26	44	68 gm. half white bread, 174 gm. white bread, 335 gm. broth, 149 gm. veal cutlet, 74 gm. roast veal (1 day), 472 gm. milk, 160 gm. almond milk, 660 gm. tea.	5	14.0	14.5	1.6	—2.1	Pyelo nephritis suppuratura.
2137	1888	.....do	.....do	26	43	148 gm. half white bread, 137 gm. white bread, 355 gm. soup, 171 gm. roasted meat (1 day), 145 gm. veal cutlet (2 days), 146 gm. roast veal, 138 gm. chicken, 616 gm. milk, 345 gm. almond milk, 360 gm. tea, 600 gm. water.	8	19.6	15.1	1.4	+3.1	Pyelo nephritis suppuratura. Subject was given vichy water.
2138	1888	.....do	.....do	26	43	93 gm. half white bread, 166 gm. white bread, 114 gm. broth, 146 gm. veal cutlet (1 day), 114 gm. chopped cutlet, 146 gm. roast veal (1 day), 218 gm. chicken, 611 gm. almond milk, 503 gm. milk, 880 gm. tea	4	24.6	17.6	2.6	+4.4	Pyelo nephritis suppuratura.
2139	1890	Prior	Man	19	......	2,000 cc. milk, 100 gm. white bread	5	13.9	12.6	0.6	+0.7	Nephritis.
2140	1890	.....do	.....do	19	......	2,000 cc. milk, 100 gm. white bread, 8 eggs	1	21.1	18.1	0.8	+2.2	Do.
2141	1890	.....do	.....do	19	......	.....do	2	13.9	14.8	0.9	—1.8	Do.
2142	1890	.....do	.....do	19	......	.....do	3	13.9	12.6	0.6	+0.7	Do.
2143	1890	.....do	.....do	19	......	2,000 cc. milk, 100 gm. white bread, 4 raw eggs	1	17.8	17.1	0.6	+0.1	Do.
2144	1890	.....do	.....do	19	......	.....do	3	13 9	12.6	0.8	+0.5	Do.
2145	1890	.....do	Man	40	......	100 gm. meat, 150 gm. potato, 1,100 cc. milk, 200 gm. bread, 30 gm. butter, 600 cc. water.	3	13.5	12.7	0.5	+0.3	Bright's disease.
2146	1890	.....do	.....do	40	......	100 gm. meat, 150 gm. potato, 1,100 cc. milk, 200 gm. bread, 30 gm. butter, 600 cc. water, 8 soft-boiled eggs.	1	21.5	19.9	0.8	+0.8	Do.
2147	1890	.....do	.....do	40	......	Same as No. 2145	1	13.5	12.8	0.4	+0.3	Do.
2148	1890	.....do	.....do	40	......	.....do	1	13.5	13.2	0.5	—0.2	Do.
2149	1890	.....do	.....do	40	......	14 raw eggs	1	18.8	11.4	1.6	+0.8	Do.
2150	1890	.....do	.....do	40	......	Same as No. 2145	1	13.5	12.6	0.6	+0.3	Do.
2151	1890	.....do	.....do	40	......	14 raw eggs	4	13.8	11.3	0.8	+1.7	Do.
2152	1890	.....do	.....do	40	......	Same as No. 2145	3	13.5	13.2	0.7	—0.4	Do.
2153	1890	.....do	.....do	40	......	14 soft-boiled eggs	4	13.8	13.0	0.6	+0.2	Do.
2154	1890	.....do	.....do	40	......	Same as No. 2145	2	13.5	12.9	0.8	—0.3	Do.
2155	1890	.....do	Man	57	......	1,500 cc. milk, 100 gm. bread	2	10.7	6.7	0.7	+3.3	Sclerosis of the kidneys.
2156	1890	.....do	.....do	57	......	.....do	1	10.7	6.5	0.8	+3.4	Do.
2157	1890	.....do	.....do	57	......	1,500 cc. milk, 100 gm. bread, 6 soft-boiled eggs	2	16.7	10.1	0.8	+5.8	Do.
2158	1890	.....do	.....do	57	......	1,500 cc. milk, 100 gm. bread	4	10.7	9.3	0.8	+0.6	Do.
2159	1890	.....do	.....do	57	......	.....do	2	10.7	6.9	1.0	+2.8	Do.
2160	1890	.....do	.....do	57	......	.....do	1	10.7	6.8	0.9	+3.0	Do.
2161	1890	.....do	.....do	57	......	11 raw eggs	3	10.9	7.3	1.0	+2.6	Do.
2162	1890	.....do	.....do	57	......	Same as No. 2155	1	10.7	7.4	0.8	+2.5	Do.
2163	1890	.....do	Man	34	......	500 cc. tea, 130 gm. bread, 400 gm. meat, 150 gm. potato, 150 cc. milk.	2	16.4	13.6	0.9	+1.9	Chronic parenchymatous nephritis.
2164	1890	.....do	.....do	34	......	Same as No. 2155, 1 day before and 3 after No. 2165.	4	16.4	12.6	1.0	+2.8	Do.
2165	1890	.....do	.....do	34	......	--raw eggs	3	16.2	11.9	0.7	+3.6	Do.
2166	1890	.....do	Man	47	......	200 gm. meat, 200 gm. potato, 100 gm. bread	2	8.9	9.8	1.0	—1.9	Do.
2167	1890	.....do	.....do	47	......	.....do	1	8.9	9.5	0.9	—1.5	Do.
2168	1890	.....do	.....do	47	......	200 gm. meat, 200 gm. potato, 100 gm. bread, 4 soft-boiled eggs.	2	12.8	13.1	1.0	—1.3	Do.

TABLE 23.—*Experiments with subjects with diseases of the kidneys*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2169	1890	Prior	Man	47	......	200 gm. meat, 200 gm. potato, 100 gm. bread	1	8.9	9.3	1.0	—1.4	Chronic parenchymatous nephritis.
2170	1890	do	do	47	......	Same as No. 2166	1	8.9	8.9	1.1	—1.1	Do.
2171	1890	do	do	47	......	9 raw eggs, 200 cc. water	1	8.9	6.1	3.0	—0.2	Do.
2172	1890	do	do	47	......	Same as No. 2166	2	8.9	8.4	0.9	—0.4	Do.
2173	1890	do	Man	47	......	200 gm. meat, 250 cc. milk. 120 gm. bread	2	9.9	8.0	1.1	+0.8	Chronic interstitial nephritis.
2174	1890	do	do	47	......	200 gm. meat, 250 cc. milk. 120 gm. bread, 5 soft-boiled eggs.	3	14.8	13.3	1.3	+0.2	Do.
2175	1890	do	do	47	......	200 gm. meat, 250 cc. milk, 120 gm. bread	2	9.9	8.9	0.7	+0.3	Do.
2176	1890	do	do	47	......	200 gm. meat, 250 cc. milk, 120 gm. bread, 5 raw eggs.	3	14.8	13.4	1.3	+0.1	Do.
2177	1890	do	do	47	......	200 gm. meat, 250 cc. milk, 120 gm. bread	2	9.9	8.5	0.9	+0.5	Do.
2178	1890	do	do	47	......	do	1	9.9	8.3	1.1	+0.5	Do.
2179	1890	do	do	47	......	10 raw eggs, 250 cc. water	4	9.9	7.4	1.1	+1.4	Do.
2180	1890	do	do	47	......	Same as No. 2173	2	9.9	9.4	0.8	—0.3	Do.
2181	1891	P. Müller	Maid servant (H.)	25	......	Bread, soup, egg, potato, milk, meat, coffee	8	14.1	8.5	2.0	+3.6	Chronic nephritis. Subject was given infusum juniperii. The diet contained an abundance of nitrogen. Nitrogen in urine includes 1.2 gm. from albumen.
2182	1891	do	do	25	......	Bread, vegetables, soup, egg, meat, butter, sugar, coffee.	8	8.2	7.9	1.2	—0.9	Chronic nephritis. Subject was given infusum digitalis several days. The diet contained a limited amount of nitrogen. Nitrogen in urine includes 1.0 gm. from albumen.
2183	1891	do	do	25	......	Diet similar to No. 2181	8	16.7	10.7	1.5	+4.5	Chronic nephritis. Subject was given infusum juniperii. The diet contained an abundance of nitrogen. Nitrogen in urine includes 1.6 gm. from albumen.
2184	1891	do	do	25	......	......	......	15.4	9.6	1.8	+4.0	Average of Nos. 2181 and 2183.

2185	1891	....do	....do	25	....	Mixed diet..	9	17.0	13.9	1.5	+1.6	Chronic nephritis with symptoms of granular atrophy. Nitrogen in urine includes 1.2 gm. from albumen.
2186	1891	Von Noorden and Ritter.	Woman (K.)........	37	....	1,500 cc. milk, meat, white bread, butter.....	5	17.7	9.9	2.9	+4.9	Shriveled kidney. Diet rich in protein.
2187	1891	.....do	Woman (M.)........	27	46	1,000 cc. milk, meat, eggs, butter, white bread.	7	12.3	11.0	1.8	—0.5	Shriveled kidney. Nitrogen in urine—average of 8 days.
2188	1891	.....do	Woman (M.)........	38	56.5	1,500–2,000 cc. milk, butter, white bread, eggs (4 days).	9	13.2	10.1	0.6	+2.5	Shriveled kidney. Largely milk diet. Nitrogen in urine—average of 8 days.
2189	1891	.....do	Woman (K.)........	43	50	2,000 cc. milk, butter, zweiback, white bread.	7	14.3	11.0	0.6	+2.7	Do.
2190	1891	.....do	.....do	43	....	1,000 cc. milk, meat, eggs, zweiback	9	12.8	12.8	0.8	—0.8	Shriveled kidney. Milk, meat, egg diet. Nitrogen in urine—average of 7 days.
2191	1891	.....do	Woman (P.)........	22	78	1,000–2,000 cc. milk, bread, butter, eggs, meat.	27	14.2	12.8	1.6	—0.2	Nephritis parenchymatosa chronica. Nitrogen in urine—average of 24 days.
2192	1892	Mann............	Man (L.)............	45	....	1,000 gm. milk, 72 gm. rolls, 50 gm. bread, 400 gm. vegetables, 80 gm. meat and gravy, 500 gm. soup. 40 gm. butter.	1	11.3	6.7	2.1	+2.5	Chronic nephritis.
2193	1892	.....do	.....do	45	....	2,000 gm. milk	3	9.7	6.2	2.4	+1.1	Do.
2194	1892	.....do	.....do	45	....	1,000 gm. milk, 72 gm. rolls, 75 gm. bread, 400 gm. vegetables, 65 gm. meat and gravy, 500 gm. soup, 40 gm. butter.	2	11.1	6.6	2.0	+2.5	Do.
2195	1892	.....do	.....do	45	....	2,000 gm. milk	2	8.8	5.7	2.9	+0.2	Do.
2196	1892	.....do	.....do	45	....	1,000 gm. milk, 72 gm. rolls, 80 gm. bread, 80 gm. beef, 400 gm. vegetables, 40 gm. butter, 1,000 gm. soup.	1	14.1	5.2	1.0	+7.0	Do.
2197	1892	.....do	.....do	45	....	1,000 cc. milk, 133 gm. bread, 87 gm. meat, vegetables, etc.	3	10.5	4.6	1.5	+4.4	Do.
2198	1892	.....do	Man (N.)...........	53	.....	2,310 gm. milk, 107 gm. meat, 145 gm. rolls, 227 gm. bread, 500 gm. soup, potato, etc.	3	20.9	10.1	2.1	+8.7	Sclerosis of the kidneys.
2199	1892	.....do	.....do	53	....	2,670 gm. milk	3	13.2	8.9	1.8	+2.5	Do.
2200	1892	.....do	Man (H.)...........	29	....	2,000 gm. milk, 303.5 gm. rolls, 6 eggs	2	17.5	15.4	1.6	+0.5	Do.
2201	1892	.....do	.....do	29	....	2,000 gm. milk, 305.5 gm. rolls, 6 eggs	3	17.5	10.8	1.4	+5.3	Do.
2202	1892	.....do	.....do	29	....	2,000 gm. milk, 304.6 gm. rolls, 6 eggs	5	17.5	12.6	1.5	+3.4	Average of entire test (Nos. 2200, 2201).
2203	1892	.....do	Man (M.)...........	26	....	2,000 gm. milk, 290 gm. rolls, 7 eggs	3	20.1	10.8	2.1	+7.2	Amyloid degeneration of the kidneys.
2204	1892	Kornblum	Man (S.)...........	49	62	250 gm. bread, 150 gm. meat, 40 gm. butter, 400 cc. milk, 700 cc. beer, 1,000 cc. coffee, 500 cc. bouillon, 3 eggs, 500 cc. cognac (3 days), 266 cc. water (3 days), (95.3 gm. protein, 82.4 gm. fat, 221.1 gm. carbohydrates, 44.2 gm. alcohol, 2,372.8 calories).	4	15.3	11.8	0.5	+3.0	Chronic nephritis. Nitrogen in urine includes 0.7 gm. from albumen.

TABLE 23.—*Experiments with subjects with diseases of the kidneys*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2205	1892	Kornblum	Man (S.)	49	62	250 gm. bread, 107 gm. meat, 5 gm. egg, 60 gm. butter, 100 cc. milk, etc. (85.6 gm. protein, 87.6 gm. fat, 204 gm. carbohydrates, 25.4 gm. alcohol, 2,261.2 calories).	11	13.9	12.2	0.4	+1.3	Chronic nephritis. Nitrogen in urine includes 0.6 gm. from albumen.
2206	1892	....do	....do	49	62	....do	3	14.6	14.4	0.4	—0.2	Chronic nephritis. Last three days of No. 2205. Nitrogen in urine includes 0.5 gm. from albumen.
2207	1892	....do	Tinsmith (G.)	28	57	150 gm. bread, 150 gm. meat, 43 gm. butter, 1,000 cc. milk, 83 cc. red wine, 500 cc. coffee, 500 cc. bouillon, 3 eggs, 20 gm. sugar, 483 cc. water (99.2 gm. protein, 94.8 gm. fat, 147.2 carbohydrates, 76 gm. alcohol, 1,713 calories).	6	15.9	10.6	1.7	+3.6	Amyloid degeneration of the kidneys and phthisis. Nitrogen in urine includes 3.5 gm. from albumen and 0.3 gm. from sputa.
2208	1893	Baginsky	Girl	13½	21.8	2,594 cc. milk	5	12.5	10.2	0.7	+1.6	Albumenuria.
2209	1893	....do	Girl	13¾	28.2	2,900 cc. milk	5	14.0	11.9	0.6	+1.5	Do.
2210	1893	....do	Girl	5	13.9	2,700 cc. milk	6	13.0	7.6	1.3	+4.1	Do.
2211	1893	....do	Girl	12	27	1,600 cc. milk, 680 gm. rice, 280 gm. bread	3	11.9	7.6	2.1	+2.2	Do.
2212	1893	....do	Girl	5	16.9	295 gm. milk, 151 gm. meat, 76 gm. boiled ham, 200 gm. bouillon, 43 gm. butter, 14 gm. cheese, 93 gm. egg, 47 gm. bread, 73 gm. spinach (2 days), 172 gm. coffee, 52 gm. red wine, 208 gm. water, 200 gm. Carlsbad Mühlbrun water.	3	12.2	11.3	1.0	—0.1	Diabetes mellitus.

Nos. 2105–2114. Vrach, 7, p. 181. Nos. 2115–2117. The quantitative and qualitative metabolism of nitrogen in diseases of the kidneys. Inaug. Diss. (Russian), St. Petersburg, 1888, Tables 1, 2, p. 81. Nos. 2118, 2119. Ibid., Tables 3, 4, pp. 82, 83. Nos. 2120–2131. Ibid., Tables 5, 6, pp. 84, 86. Nos. 2132–2135. Ibid., Tables 7, 8, pp. 90, 92. Nos. 2136–2138. Ibid., Tables 9, 10, pp. 94, 96. Nos. 2139–2141. Ztschr. klin. Med., 18, pp. 120, 121. Nos. 2142–2145. Ibid., pp. 123, 124. Nos. 2146–2152. Ibid., pp. 125, 126. Nos. 2153–2158. Ibid., pp. 129, 130. Nos. 2159–2165. Ibid., pp. 134, 135. Nos. 2166–2172. Ibid., pp. 139, 140. Nos. 2173–2177. Ibid., p. 142. Nos. 2178–2180. Ibid., p. 145. Nos. 2181–2184. Über Stickstoffaufnahme und Stickstoffausscheidung bei chronischer Nephritis. Inaug. Diss. Berlin, 1891, pp. 17, 18. No. 2185. Ibid., p. 22. No. 2186. Ztschr. klin. Med. 19, Sup., pp. 201, 213. No. 2187. Ibid., pp. 201, 214. No. 2188. Ibid., pp. 200, 216. Nos. 2189, 2190. Ibid., pp. 200, 217. No. 2191. Ibid., pp. 200, 210. Nos. 2192–2194. Ztschr. klin. Med., 20, p. 114. Nos. 2195–2197. Ibid., p. 115. Nos. 2198, 2199. Ibid., p. 120. Nos. 2200–2202. Ibid., p. 122. No. 2203. Ibid., p. 125. No. 2204. Virchow's Arch., 127, p. 416. Nos. 2205, 2206. Ibid., p. 431. No. 2207. Ibid., p. 440. No. 2208. Arch. Kinderheil, 15, p. 165. No. 2209. Ibid., p. 168. No. 2210. Ibid., p. 173. No. 2211. Ibid., p. 176. No. 2212. Ibid., p. 186.

Nos. 2105–2114 were made by Korkounov at St. Petersburg in 1886 (?). The object was to study the influence of a sudorific treatment on metabolism and the assimilation of the protein of milk in chronic inflammation of the kidneys.

Persons were selected as subjects who had well-defined chronic inflammation of the kidneys and anarsaca as a prominent symptom. Four experiments were made, each divided into two periods. During the experiment the subjects received milk exclusively. Before the experiment they received the milk, white bread, and cutlet. The nitrogen of the milk, urine, and feces was determined by the Kjeldahl-Borodin method. The albumen in the urine was estimated by the gravimetric method. The sudorific treatment consisted of baths. During the last period of each experiment two baths of 40° C. and 15 to 25 minutes' duration were given daily. After the bath the subjects were wrapped in blankets.

The following conclusions were reached: The weight of the subjects decreased during both periods. At the same time the dropsy diminished. In two cases on the last day of the experiment the dropsy had entirely disappeared and the weight of the patients increased a little.

The assimilation of the milk varied considerably in different subjects, the limits being 82.57 per cent and 93.83 per cent.

The more developed the dropsy the poorer the nitrogen assimilation. Under the influence of the baths the assimilation improved in every case. The limits were 86 and 95.39 per cent. During the first period the subjects not only maintained a nitrogen equilibrium, but even gained some nitrogen. Under the sudorific treatment a still greater amount of nitrogen was retained.

Nos. 2115–2138 were made by Grigoriev in St. Petersburg in 1888. The object was a study of the quantitative and qualitative metabolism of nitrogen in diseases of the kidneys. The subjects were men suffering from some form of kidney disease. Five experiments are described. The general plan followed was to keep the patients on an absolute milk diet or a bread and milk diet for several days, this period being preceded and followed by a period on mixed diet. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. During the last 4 days the subject of Nos. 2115–2117 was given warm baths.

The subject of experiment Nos. 2120–2132 was under observation 40 days. During this time he received alternately a mixed diet and one of milk with bread. The medical treatment consisted of hot baths and digitalis and similar drugs. The patient died.

The subject of experiment Nos. 2126–2138 was treated with vichy and lithium bromid solution and baths of 30° C. He died some months after the conclusion of the experiment.

The author's general conclusions are as follows:

The qualitative metabolism of nitrogen in nephritic subjects is inferior to that of healthy subjects, while the quantitative metabolism of nitrogen is sometimes inferior and sometimes superior. Many conditions influence this change.

The absolute quantities of uric acid and extractives in the urine of nephritic subjects are not lower than in healthy persons, but the relative amounts are higher than the normal.

The excretion of uric acid and extractives in the urine of nephritic subjects does not stand in either direct or inverse relation to the outgo of urea. This indicates that these substances are formed by independent processes in the body.

The excretion of uric acid in the urine of nephritic subjects fluctuates less than that of extractives.

The individuality of the subject and the peculiarities of the disease materially influence the changes in the metabolism of nitrogen in diseases of the kidneys. This accounts for the contradictory results obtained by various investigators.

Nos. 2139–2180 were made by Prior in Bonn (?), in 1889–90, to study the influence of the consumption of albumen upon the functions of the kidneys. The subjects were suffering from some disease of the kidneys which caused an excretion of albumen in the urine. The food consisted of bread, meat, milk, potatoes, and eggs.

The subjects consumed a diet with a moderate amount of protein for a few days, then for a short period the amount of protein was considerably increased by adding eggs to the dietary. The ordinary diet was then resumed. In most cases, trials were made in which the subjects consumed cooked or raw eggs alone. These periods were also preceded and followed by periods with the usual diet. The nitrogen in the food was either determined or calculated from König's tables. The nitrogen in the urine and feces was determined and also the albumen, uric acid, phosphoric acid, and in some cases the urea and sulphuric acid in the urine.

The author concludes that coagulated egg albumen consumed with other food or alone does not cause an excretion of albumen in the urine in healthy subjects, nor does it have any bad effect on subjects with albuminuria. When raw egg albumen is consumed with other food it does not usually cause an excretion of albumen in the urine of healthy individuals, and is also harmless for subjects with albuminuria. When raw egg albumen alone is consumed it often causes an excretion of albumen in the urine of healthy individuals and increases the excretion of albumen in subjects suffering from albuminuria. The results vary considerably, however, with different forms of kidney disease.

The article contains many references to previous work, and much matter interesting from a medical standpoint.

Experiments were also made with dogs, rabbits, and guinea pigs, and with healthy men. They were not complete metabolism experiments and therefore are not included in the present compilation.

Nos. 2181–2185 were made by P. Müller at the Charité Hospital in Berlin in 1890 to study the metabolism of nitrogen in chronic nephritis. The subject was a maid servant—a patient in the hospital—suffering from this disease. Throughout the whole experiment the food was a simple mixed diet consisting of bread, meat, soup, potatoes, etc., varied somewhat from day to day. The experiment was divided into four periods. In Nos. 2181, 2183, and 2185 the diet contained an abundance of nitrogen, and in No. 2182 a limited amount. An interval of several weeks separated Nos. 2183 and 2185. At this time the subject manifested symptoms of granular atrophy of the kidneys. The feces were separated by means of charcoal. The nitrogen in the food was calculated from Klemperer's compilation,[1] which includes many analyses of foods served in the Charité Hospital. The nitrogen in the feces was determined by the Kjeldahl-Borodin method, and the urea in the urine by the Liebig-Pflüger method. The albumen in the urine was estimated by means of Esbachscher's albuminimeter.

The following conclusions were drawn: Generally speaking, during the earlier stages of the disease the subject gained nitrogen, provided the amount consumed exceeded 9 or 10 grams daily. This gain was observed even when the quantity of urine was large. It was possible by diminishing the amount of protein consumed to prevent a gain of nitrogen, provided the excretion of urine was not excessive. When the symptoms of granular atrophy occurred less nitrogen was retained than before, the amount being inversely proportional to the quantity of urine excreted. When 18.8 grams of nitrogen was consumed daily it was not possible to store up nitrogen if the excretion of urine was correspondingly large.

The author discusses the experiments at length from a medical standpoint, with special reference to uræmia.

Nos. 2186–2191 were made by von Noorden and Ritter in Professor Gerhardt's clinic in Berlin in 1890–91. The object was to investigate (1) the absorption of nutrients; (2) to see if a change in the composition of the diet had an effect on the action of the kidneys, and (3) to see if albuminuria was influenced by the diet. The subjects were 3 women suffering from some form of kidney disease. The food consisted of a simple mixed diet. The protein was furnished by various combinations of meat, milk, and eggs. The supposition [of the compilers] is that the nitrogen and fat were

[1] Grundriss de klinischen Diagnostik.

determined in the food and feces, and the nitrogen, albumen, and, in some cases, phosphoric acid in the urine. In discussing the outgo of nitrogen in the urine in one of the experiments (No. 2191) the author divides the whole time—24 days—into five periods, while in the statements concerning the food and feces the whole time—27 days—is divided into six periods. It is presumable that the last 24 days are those which correspond to the days on which the outgo of nitrogen in the urine is given. They were divided into periods of 5, 4, 4, 6, and 5 days' duration, respectively. The nitrogen consumed was derived from milk and eggs in the first period; from meat, milk, and eggs in the second and fourth periods; from milk in the third period; and from milk and meat in the fifth period. Baths which induced sweating were given in the last period.

When the balance of income and outgo is computed on the above basis the results obtained differed somewhat from those given by the authors. The figures are therefore not quoted in detail, since it was not certain that the periods in which income and outgo were recorded coincided, as was assumed above.

The conclusion was reached that in kidney disease the amount of nutrients excreted in the feces does not differ in any regular way from that in health. The form in which protein was consumed had no influence on the action of the kidneys. No conclusion was drawn regarding the influence of the diet on albuminuria. The article contains much matter which is interesting from a medical standpoint.

Nos. 2192–2203 were made by Mann at the first medical clinic of the University of Berlin in 1890–91 to investigate the excretion of nitrogen in subjects with diseases of the kidneys. The opinions of a number of earlier investigators on this subject are quoted. Some of the experiments are referred to in detail. As shown by these citations, the opinion is quite general that acute nephritis diminishes the excretion of nitrogen.

The author reports experiments with 4 men. L., 45 years old, was suffering from chronic nephritis; N., 54 years old, and H., 29 years old, from sclerosis of the kidneys, and M., 26 years old, from amyloid degeneration of the kidneys. L., M., and N. had more or less pronounced edema or anasarca. N. died shortly after the close of the test. H. had a very severe attack immediately before the test. With the subjects L. and N., periods on a mixed diet were followed by periods on an absolute milk diet. The mixed diet consumed by L. was believed to furnish as much protein and energy as was required, since the subject remained in bed during the test. The milk diet furnished considerable less protein and energy. The mixed diet consumed by N. was similar in kind and amount to that which he was accustomed to. H. and M. consumed a simple diet of milk, rolls, and eggs. All the subjects were given charcoal emulsion to facilitate the separation of the feces. The nitrogen in the urine and feces, and in all the articles of food except butter, was determined by the Kjeldahl method. The nitrogen in the butter was calculated from König's figures. The albumen in the urine was usually determined by an Essbach albuminimeter, and sometimes by weighing the precipitated albumen. The nitrogen was always determined in two samples of urine, the albumen in one sample being first removed by precipitation with acetic acid. The author calculated the amount of albumen present in the urine by multiplying the difference in the nitrogen content of the two samples by 6.25. The results when albumen was thus determined were found to agree very closely with those obtained by precipitation and weighing, and were more uniform than those obtained by using the Essbach albuminimeter. In every case the outgo of nitrogen was less than the income; that is, some nitrogen was stored in the body. This was particularly noticeable with the subject of Nos. 2192–2196 in the periods on an absolute milk diet, when the food furnished less nitrogen and energy than it was believed the subject would require under normal conditions.

From the experiments as a whole, the conclusion was drawn that in diseases of the kidneys nitrogen equilibrium can be reached when only a small amount of nitrogen is consumed. If the amount of nitrogen consumed is increased, there is usually a

considerable retention of nitrogen, which is stored up in the edema. If the amount of nitrogen consumed is diminished, the amount excreted increases until nitrogen equilibrium is reached. The retention of nitrogen sometimes causes uræmia.

Nos. 2204–2207 were made by Kornblum in the Moabit Hospital in Berlin in 1892 (?). Some of the analytical work, i. e., on the feces, was done in the laboratory of the Pathological Institute. The object of the experiments was an investigation of nitrogen metabolism in man where the kidneys were diseased. In speaking of metabolism in disease the author says, in effect, there are many diseases, particularly those of a more or less morbid nature, which drugs do not permanently relieve. In such cases the most important thing is to so arrange the diet that the subject may be maintained in a well-nourished condition as long as possible, and to better his condition if he is not well nourished. Investigators have given attention chiefly to protein, since it is well known that while fat and carbohydrates may replace each other, or under certain conditions be omitted altogether, some protein is absolutely essential. The smallest quantity of protein which in combination with fat and carbohydrates will serve for the needs of the body is called "protein for maintenance."

The subjects in Kornblum's experiments were 2 patients in the Moabit Hospital, one suffering from chronic nephritis and the other from amyloid degeneration of the kidneys and phthisis. These men were chosen because it seemed desirable to select subjects suffering from some form of Bright's disease. For purposes of comparison with a normal individual several series of experiments were made, in which the investigator was himself the subject. The results could not be included in the present compilation, since they were not reported with sufficient detail. In the experiments made with the men suffering from kidney disease the nitrogen in all the food except meat and eggs was determined. For the nitrogen of meat Voit's value, 3.4 per cent, was used. The fat in the meat was calculated from König's figures. The nitrogen and fat in the eggs were calculated from values given by Voit. The carbohydrates, fat, alcohol, and fuel value in the various articles of food were calculated from the best available data. The urine was boiled with a little acetic acid; the albumen was filtered off and determined. The nitrogen and phosphoric acid in the urine and the nitrogen in the feces were determined also. In No. 2207 the nitrogen in the sputa was determined.

The principal conclusion from these experiments was that there is no diminution in the amount of nitrogen excreted due to nephritis, although the nitrogen metabolism is much retarded by it.

Nos. 2208–2212 were made by Baginsky in Berlin in 1891–92. The object of these experiments was to study the pathology of the kidneys during childhood. The subjects were young girls. Those in Nos. 2208–2211 were patients in the Emperor and Empress Frederick Hospital suffering from nephritis or other disease which caused albumen in the urine. The subject of No. 2212 had diabetes mellitus. In Nos. 2208–2210 the food consisted of milk. In No. 2211 of milk, bread (semmel), and rice, and in No. 2212 of meat and eggs, bouillon, cheese, butter, etc., and a little coarse bread and spinach. Coffee, red wine, and Carlsbad Mühlbrun water were used as beverages. The nitrogen in food, urine, and feces was determined.

From the first 4 experiments (Nos. 2208–2211) the conclusion is drawn that in such diseases the kidneys do not excrete nitrogen as well as in health. This tendency can, however, be overcome. The greater part of the nitrogen in the urine is in the form of urea.

The discussion of the experiments is largely from a medical standpoint.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM DISEASES OF THE NERVOUS SYSTEM.

In Table 24 are included 14 tests with women suffering from hysteria. The special questions investigated are noted in the text accompanying the table.

TABLE 24.—*Experiments with subjects with diseases of the nervous system.*

Serial number.	Date of publication.	Observer.	Subject. Occupation.	Age.	Weight.	Food per day.	Duration.	Nitrogen. In food.	In urine.	In feces.	Gain (+) or loss (—).	Remarks.
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2213	1887	Bleibtreu	Woman	27	44.8	Milk, meat, eggs, bread, butter, etc. (191.3 gm. protein).	44	30.6	24.0	2.3	+4.3	Hysteria. Nitrogen in feces determined for 4 days only.
2214	1887	....do	....do	27	44.8	2,064 cc. milk, 352 gm. meat, 212 gm. egg, 30 gm. white bread, 325 gm. zwieback, 200 gm. potato, 100 gm. vegetables, 20 gm. butter, 100 gm. cakes, etc. (217.1 gm. protein).	4	34.7	25.4	2.6	+6.7	Hysteria. Four days of No. 2213 on which nitrogen in feces was determined.
2215	1889	Popov	Girl	18	90	680 cc. milk	6	4.4	7.2	0.2	—3.0	Hysteria. Milk diet.
2216	1889	....do	....do	18	......	35 gm. bread, 114 gm. meat powder, 70 gm. egg (3 days), 632 gm. milk.	6	20.8	13.3	0.5	+7.0	Hysteria. Chiefly animal food.
2217	1889	....do	....do	18	......	48 gm. bread (2 days), 165 gm. sturgeon (3 days).	5	6.1	7.9	1.1	—2.9	Hysteria. Fish and vegetable food.
2218	1889	....do	....do	18	......	240 gm. milk (2 days), 207 gm. puree of peas (2 days). 271 gm. tea, with sugar, 158 gm. potato (3 days), — gm. cutlet, 200 gm. pea soup (1 day), 60 gm. fruit (1 day), 86 gm. egg (1 day), 30 gm. baked apple (1 day).	......	10.5	9.5	0.6	+0.4	Average of Nos. 2215–2217.
2219	1889	Müller	Woman (G.)	19	34	Fasting	4	0.0	3.9	1.8	—5.7	Mental derangement.
2220	1889	....do	....do	19	32	900 cc. milk, 144 gm. egg	5	7.6	5.1	0.8	+1.7	Mental derangement. Subject lost 58 cc. food by vomiting.
2220*a*	1889	....do	....do	19	33	1,000 cc. milk, 180 gm. egg	7	9.0	6.5	0.5	+2.0	Mental derangement. Subject lost 30 cc. food by vomiting.
2220*b*	1889	....do	....do	19	34	1,472 cc. milk, 180 gm. egg	8	11.8	7.6	(0.6)	+3.6	Mental derangement.
2221	1889	....do	....do	19	34	1,470 cc. milk, 180 gm. egg, 25 gm. peptone	6	13.7	8.2	(0.6)	+4.9	Do.
2222	1889	....do	Woman (K.)	35	46	Fasting	4	0.0	6.5	0.2	—6.7	Do.
2223	1889	....do	Woman	......	......	....do	1	0.0	4.2	0.0	—4.2	Do.
2224	1889	....do	....do	......	......	Practically fasting	1	0.0	4.4	0.0	—4.4	Do.
2225	1889	....do	Woman (L.)	40	51	....do	6	0.0	5.5	0.2	—5.7	Do.
2226	1889	....do	....do	40	50	59.6 gm. bread, 15.5 gm. butter	4	0.9	5.5	0.2	—4.8	Do.

Nos. 2213, 2214. Pflüger's Arch., 41, pp. 409, 410. Nos. 2215–2218. Vrach, 10, p. 771. No. 2219. Ztschr. klin. Med., 16, p. 505. Nos. 2220, 2221. Ibid., pp. 506–508. No. 2222. Ibid., p. 510. Nos. 2223, 2224. Ibid., p. 511. Nos. 2225, 2226. Ibid., p. 512.

Nos. 2213, 2214 were made by Bleibtreu at the laboratory of the Physiological Institute in Bonn in 1887 (?). The object of the investigation was to observe the effect of the Weir-Mitchell cure on metabolism. The Weir-Mitchell cure, which is recommended for cases of hysteria, consists in increasing very greatly the food consumption, particularly the protein, and at the same time employing massage. In such treatment it was by no means certain that the increased food was digested and benefited the organism. The subject was a woman, 1.66 meters tall. She had been ill for many years with an irritation of the spine, which caused hysteria. With great difficulty, she could walk a few steps only. She spent most of her time in bed or lying on a couch. She ate very little and had a very marked nervous dyspepsia. Part of the spinal region was very tender and the subject could not endure the light. She had no organic disease.

The food, which was very abundant, consisted of meat, milk, eggs, bread, potatoes, vegetables, butter, zwieback, and cakes of some sort. No details of the daily food consumption are given by the author. The protein of the food was estimated from König's tables. The nitrogen in the urine was determined. The urine was collected for several days, phenol being added as a preservative, and samples were taken for analysis. The nitrogen in the feces was determined on 4 days and the mean value, 7.57 per cent, taken as representing the percentage of undigested protein in the feces during the whole period.

At the close of the experiment the patient was in good health and could walk several hours per day. The lameness in the back had disappeared. She had gained 15.84 kilograms in weight, and the author calculated that 7.414 kilograms of this was muscular tissue. The Weir Mitchell cure in this case was certainly beneficial.

Nos. 2215–2218 were made by Popov in St. Petersburg in 1889. The object was to study the influence of hysteria on metabolism. The subject was a girl who suffered from hysterical paralysis, local anæsthesis, hyperæsthesis, etc. The experiment lasted 7 days, and was divided into three periods, the first with an exclusive milk diet, the second with a diet largely of animal food, and the third with a fish and vegetable diet. The patient remained in bed during the experiment. During the period with the animal food (chiefly meat powder) the patient was forced to eat a considerable amount.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method, the urea by Borodin's method.

The author had no data which would enable him to compare the metabolism of the patient while suffering with hysteria with her metabolism in health. He endeavored, therefore, to compare the results obtained by him with the results ordinarily accepted for a girl of 18 years in normal health. He draws the following conclusions: The practical interest in this experiment lies not only in the lowered nutrition, which suggests somewhat that of hibernating animals, but in the fact that the nutrition can be so easily improved by artificial and copious feeding. A forced diet appears to be beneficial in cases of enfeebled nervous functions where there is a tendency in the organism to be maintained on a low level of metabolism.

Nos. 2219–2226. See Nos. 1955–1962, Table 19.

EXPERIMENTS WITH SUBJECTS SUFFERING FROM DISEASES OF THE BONES.

In Table 25 are included 14 tests with men and 1 with a boy suffering from diseases of the bones or from fractured bones. The special questions investigated are noted in the text accompanying the table.

TABLE 25.—*Experiments with subjects with diseases of the bones.*

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2227	1885	Raspopov	Soldier (G.)	21	47.0	300 gm. meat, 600 cc. milk, 600 gm. white bread, 1,515 cc. water.	6	30.7	17.7	1.4	+11.6	Osteo-periostitis. P_2O_5 in food, 4.9 gm.; in urine, 1.7 gm.; in feces, 0.9 gm.; gain, 2.3 gm.
2228	1885	....do	Soldier (P.)	22	64.3	300 gm. meat, 600 cc. milk, 600 gm. white bread, 2,025 cc. water.	3	29.6	22.6	1.2	+ 5.8	Spondylitis. P_2O_5 in food, 5.7 gm.; in urine, 2.4 gm.; in feces, 0.8 gm.; gain, 2.5 gm.
2229	1885	....do	....do	22	65.6	300 gm. meat, 600 cc. milk, 600 gm. white bread, 1,683 cc. water.	3	31.0	25.9	1.5	+ 3.6	Spondylitis. One month after No. 2228. P_2O_5 in food, 5.1 gm.; in urine, 3 1 gm.; in feces, 0.6 gm.; gain, 1.4 gm.
2230	1885	....do	Peasant (S.)	19	43.8	300 gm. meat, 600 cc. milk, 600 gm. white bread, 2,363 cc. water.	4	30.8	24.6	1.9	+ 4.3	Caries sterni. Nitrogen in feces = average of 3 days only. P_2O_5 in food, 5.6 gm.; in urine, 2.6 gm.; in feces, 1.4 gm.; gain, 1.6 gm.
2231	1885	....do	Peasant (A.)	63	59.3	300 gm. meat, 600 cc. milk, 600 gm. white bread, 2,475 cc. water.	4	30.8	24.0	2.0	+ 4.8	Caries os calcanei sinistri. Nitrogen in feces = average of 2 days only. P_2O_5 in food, 5.6 gm.; in urine, 1.9 gm.; in feces, 1.5 gm.; gain, 2.2 gm.
2232	1885	....do	Soldier (N.)	25	66.1	300 gm. meat, 600 cc. milk, 589 gm. white bread, 1,643 cc. water.	3	29.3	21.4	2.8	+ 5.1	Coxitis dex. P_2O_5 in food, 5.6 gm.; in urine, 2.4 gm.; in feces, 2.8 gm.; gain, 0.4 gm.
2233	1885	....do	Student (K.)	26	55.6	300 gm. meat, 600 cc. milk, 475 gm. white bread, 1,800 cc. water.	3	32.0	25.6	2.4	+ 4.0	Normal health. Nitrogen in feces = average of 2 days only. P_2O_5 in food, 4.8 gm.; in urine, 3.1 gm.; in feces, 1.5 gm.; gain, 0.2 gm.

TABLE 25.—*Experiments with subjects with diseases of the bones*—Continued.

Serial number.	Date of publication.	Observer.	Subject.			Food per day.	Duration.	Nitrogen.				Remarks.
			Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2234	1885	Raspopov........	Student (E.)........	23	55.6	300 gm. meat, 600 cc. milk, 600 gm. white bread, 1,988 cc. water.	4	32.5	25.6	1.9	+ 5.0	Normal health. Nitrogen in feces = average of 2 days only. P_2O_5 in food, 4.6 gm.; in urine, 3.2 gm.; in feces, 0.8 gm.; gain, 0.6 gm.
2235	1885	.....do	Student (K.)........	26	65.6	300 gm. meat, 600 cc. milk, 600 gm. white bread, 1,913 cc. water.	4	32.5	26.8	1.7	+ 4.0	Normal health. Nitrogen in feces = average of 2 days only. P_2O_5 in food, 4.6 gm.; in urine, 3.4 gm.; in feces, 1.0 gm.; gain, 0.2 gm.
2236	1885	.....do	Soldier (Ch.)........	24	64.7	300 gm. meat, 600 cc. milk, 600 gm. white bread, 2,308 cc. water.	3	30.2	24.1	4.3	+ 1.8	Normal health. P_2O_5 in food, 5.9 gm.; in urine, 3.0 gm.; in feces, 2.6 gm.; gain, 0.3 gm.
2237	1885	.....do	Soldier (D.).........	23	67.1	300 gm. meat, 600 cc. milk, 600 gm. white bread, 2,383 cc. water.	3	30.2	25.5	3.7	+ 1.0	Normal health. P_2O_5 in food, 5.9 gm.; in urine, 3.2 gm.; in feces, 2.1 gm.; gain, 0.9 gm.
2238	1885	.....do	Peasant (V.)........	22	......	300 gm. meat, 600 cc. milk, 600 gm. white bread, 2,567 cc. water.	3	30.6	37.4	2.8	— 9.6	Fractura femoris dextris. P_2O_5 in food, 5.0 gm., in urine, 4.3 gm.; in feces, 1.1 gm.; loss, 0.4 gm.
2239	1885	.....do	Peasant (Th.).......	14	64.6	450 gm. meat, 650 cc. milk, 800 gm. white bread, 2,775 cc. water.	3	43.4	32.7	3.7	+ 7.0	Fractura femoris simstri. P_2O_5 in food, 5.6 gm.; in urine, 4.5 gm.; in feces, 2.9 gm.; loss, 1.8 gm.
2240	1885	.....do	Peasant...........	23	62.6	300 gm. meat, 600 cc. milk, 600 gm. white bread, 2,767 cc. water.	3	30.4	27.1	2.3	+ 1.0	Fractura femoris simstri. P_2O_5 in food, 4.6 gm.; in urine, 3.6 gm.; in feces, 1.5 gm.; loss, 0.5 gm.

2241	1885	.....do	Peasant (K.)........	23	64.5	450 gm. meat, 650 cc. milk, 820 gm. white bread, 2,158 cc. water.	3	41.2	26.3	3.2	+11.7	Fractura femoris simstri. P_2O_5 in food, 6.3 gm.; in urine, 4.6 gm.; in feces, 2.3 gm.; loss, 0.6 gm.

No. 2227. Assimilation and excretion of nitrogen and phosphoric acid in diseases of the bones. Inaug. Diss. (Russian), St. Petersburg, 1885, Table 1. No. 2228. Ibid., Table 2. No. 2229. Ibid., Table 3. No. 2230. Ibid., Table 4. No. 2231. Ibid., Table 5. No. 2232. Ibid., Table 6. 2233. Ibid., Table 7. No. 2234. Ibid., Table 8. No. 2235. Ibid., Table 9. No. 2236. Ibid., Table 10. No. 2237. Ibid., Table 11. No. 2238. Ibid., Table 12. No. 2239. Ibid., Table 13. No. 2240. Ibid., Table 14. No. 2241. Ibid., Table 15.

Nos. 2227–2241 were made by Raspopov in St. Petersburg in 1885. The object was to study the assimilation of nitrogen and phosphoric acid in subjects with diseases of the bones and in healthy subjects under similar experimental conditions. Five experiments were made with healthy and 8 with diseased subjects. The latter were persons with chronic diseases of the bones and with fractured bones. The food consisted of meat, milk, white bread, and water. The nitrogen in the food, urine, and feces was determined by the Kjeldahl-Borodin method. The phosphoric acid in the food, urine, and ash of the feces was determined by precipitating hot solutions of the phosphoric acid with uranium acetate in the presence of acetic acid, using potassium ferrocyanid as an indicator. To determine the phosphoric acid combined with alkaline earths 100 cubic centimeters of urine was treated with ammonia, to precipitate the alkaline earths, and after 12 hours the precipitate was removed and dissolved in citric acid. The hot solution was then treated with uranium acetate, as above.

The following conclusions were drawn: More nitrogen was assimilated by the subjects with diseased bones than by those in normal health. The healthy subjects excreted more nitrogen and phosphoric acid in the urine and more unassimilated phosphoric acid in the feces than the diseased subjects—that is, the diseased subjects retained more nitrogen and phosphoric acid than those in health. The ratio of total excreted phosphoric acid to phosphoric acid in combination with alkalies and alkaline earths was nearly the same in the diseased and healthy subjects. In one instance the metabolism of nitrogen of a subject with fractured bones was increased, and considerably more nitrogen was excreted in the urine and feces than was consumed in the food. The nitrogen metabolism of the other subjects with fractured bones did not show any variation from that of healthy subjects, and the variations in the assimilation of phosphoric acid were not uniform.

EXPERIMENTS IN WHICH THE BALANCE OF NITROGEN AND CARBON WAS DETERMINED.

In the preceding groups have been considered the experiments in which the balance of income and outgo of nitrogen was determined with or without the balance of phosphorus or other mineral matter. These experiments admit among other things of deductions concerning the gain or loss of nitrogenous tissues by the subject and the fitness of various forms of diet for the subject under different conditions. If the gain or loss of fatty tissue is to be taken into account also, the balance of carbon with or without that of oxygen and hydrogen must be measured, since this is the characteristic element of fatty tissue. A large proportion of the carbon excreted by the body is in the form of carbon dioxid of the respired air. In order to determine the amount of carbon dioxid excreted the amount and composition of the air must be determined before and after its respiration. This requires apparatus of a special kind, to which the name respiration apparatus has been applied.

Various forms of respiration apparatus have been devised by a number of investigators. They may perhaps for convenience be divided into three classes: (1) Those in which the subject remained in a closed chamber and was supplied with oxygen to take the place of that withdrawn from the air by the processes of respiration. The air in the chamber was analyzed at the beginning and end of the experiment. (2) Those in which the subject remained in a chamber supplied with a current of air, which was measured and analyzed as it entered and left the chamber. (3) Those in which the subject was not in a closed chamber, but was provided with apparatus which permitted the measurement and analysis of the inspired and expired air and the determination of the respiratory quotient. In several instances the last two forms have been combined.

A summary of the methods and results of respiration experiments, including those with man, to about the year 1882, with descriptions of the apparatus employed, has been prepared by Zuntz.[1] Since that time different forms of apparatus have been devised or the older forms have been modified, and a large number of experiments have been carried out with man and the lower animals. Many were of the class in which the respiratory quotient was determined and not the balance of income and outgo of carbon.

RESPIRATION EXPERIMENTS.

In Table 26 are included 63 tests with men, 1 with a woman, and 1 with a child, in which the balance of income and outgo of nitrogen and carbon, and sometimes also of oxygen, hydrogen, and ash, was determined. The majority of these experiments were made with a respiration apparatus. In some of the earlier experiments, however, the balance of carbon, oxygen, and hydrogen was computed, and not determined. The special form of respiration apparatus used and the questions studied are described in the text to the individual experiments.

[1] Herrmann's Handbuch der Physiologie, vol. 4, No. 2, pp. 86–162.

TABLE 26—PART I.—*Respiration experiments.*

Serial number.	Date of publication.	Subject.			Food per day.	Duration.	Nitrogen.				Carbon.				
		Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
2242	1849	Observer	29	47.5	Bread, beef, veal, vegetables, etc	5	28.0	10.9	2.8	+14.3	366.2	15.2	15.3	335.7	0.0
2243	1849	.....do	29		.....do	5	21.2	9.8	1.3	+10.1	264.9	13.7	8.9	242.3	0.0
2244	1849	Boy	6	15.0	.....do	5	7.9	3.1	1.8	+ 3.0	154.3	4.4	9.7	140.2	0.0
2245	1849	Servant	59	58.7	Bread, beef, cheese, milk, coffee	5	27.3	15.2	2.5	+ 9.6	331.8	21.2	13.6	296.8	+ 0.2
2246	1849	Woman	32	61.2	Bread, beef, veal, ham, vegetables, etc	5	22.4	10.0	0.8	+11.6	292.8	14.0	4.2	274.6	0.0
2247	1856	Soldier			Bread, meat, butter, etc. (141.9 gm. protein, 19.1 gm. fat, 550.8 gm. starch, 83 gm. crude fiber, 43.4 gm. ash, 3,120.9 gm. water).	8	23.0	14.2	7.4	+ 1.4	336.8	19.7	43.1	274.0	0.0
2248	1856	.....do			Bread, meat, butter, etc. (129.7 gm. protein, 48.5 gm. fat, 499 gm. starch, 74.7 gm. crude fiber, 44.1 gm. ash, 2,431.3 gm. water).	4	14.8	11.7	1.7	+ 1.4	301.6	16.2	9.9	275.5	0.0
2249	1856				116.8 gm. protein, 120.8 gm. fat, 262.4 gm. carbohydrates (starch), 19.5 gm. ash, 2,627.5 gm. water.		18.1	13.3	3.3	+ 1.5	270.0	18.6	19.4	232.0	0.0
2250	1862	Observer	24	73.6	Fasting; 2,100 cc. water	1	0.0	10.4	0.0	—10.4	0.0	4.5	0.0	180.8	—185.3
2251	1862	.....do	24	69.7	Fasting; 250 cc. water	1	0.0	8.0	0.0	— 8.0	0.0	3.6	0.0	180.9	—184.5
2252	1862	.....do	24	72.4	Fasting	1	0.0	8.6	0.0	— 8.6	0.0	3.7	0.0	180.9	—184.6
2253	1862	.....do	24		150 gm. fat, 300 gm. starch, 100 gm. sugar, 1,321 cc. water.	1	0.0	8.2	0.0	— 8.2	262.7	3.6	18.8	200.5	+ 39.8
2254	1862	.....do	24	71.3	1,832 gm. meat, 70 gm. fat, 31 gm. salt, 3,371 cc. water.	1	62.3	40.9	3.3	+18.1	279.6	18.0	14.9	231.2	+ 11.5
2255	1862	.....do	24		250 gm. meat, 400 gm. bread, 70 gm. starch, 70 gm. white of egg, 70 gm. fat, 30 gm. butter, 10 gm. salt, 2,100 cc. water.	1	15.9	14.8	1.1	0.0	228.7	6.5	10.6	207.5	+ 4.1
2256	1866	Watchmaker	28	70	12.5 gm. meat extract, 15.1 gm. salt, 1,027.1 gm. water, 779.9 gm. oxygen from air.	1	1.2	12.5	0.0	—11.3	2.4	8.3	0.0	201.3	—207.2
2257	1866	.....do	28		13.8 gm. meat extract, 13.2 gm. salt, 987.5 gm. water, 742.6 gm. oxygen from air.	1	1.3	12.3	0.0	—11.0	2.6	8.1	0.0	189.6	—195.1
2258	1866	.....do	28		17.8 gm. meat extract, 9.5 gm. salt, 1,978.5 gm. water, 1,071.8 gm. oxygen from air.	1	1.7	12.3	0.0	—10.6	3.5	9.3	0.0	323.9	—329.7
2259	1866	.....do	28		139.7 gm. meat, 41.5 gm. egg white, 450 gm. bread, 500 gm. milk, 1,025 gm. beer, 70 gm. fat, 30 gm. butter, 70 gm. starch, 17 gm. sugar, 4.2 gm. salt, 286.3 gm. water, 709 gm. oxygen from air.	1	19.5	17.4	2.1	0.0	315.5	12.6	14.5	248.6	+ 39.8

TABLE 26—PART II.—*Respiration experiments.*

Serial number.	Subject.			Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Occupation.	Age.	Weight.	In food.	Total excreted.	Gain (+) or loss (—).	In food.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Yrs.	*Kg.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
2242	Observer	29	47.5	265.7	265.7	0.0	57.2	57.2	0.0	31.3	9.6	5.8	+15.9	This test was made in summer.	Barral.
2243	do	29		191.4	191.4	0.0	42.8	42.8	0.0	20.1	8.6	3.5	+ 8.0	This test was made in winter.	Do.
2244	Boy	6	15.0	129.8	129.8	0.0	23.8	23.8	0.0	9.4	3.2	2.8	+ 3.4		Do.
2245	Servant	59	58.7	265.1	265.1	0.0	49.3	49.3	0.0	31.2	8.9	6.4	+15.9		Do.
2246	Woman	32	61.2	213.2	213.2	0.0	45.1	45.1	0.0	23.5	6.8	1.2	+15.5		Do.
2247	Soldier														Hildesheim.
2248	do														Do.
2249										19.6	19.5	5.7	— 5.6	Theoretical values	Do.
2250	Observer	24	73.6												Ranke.
2251	do	24	69.7												Do.
2252	do	24	72.4												Do.
2253	do	24												Diet without protein	Do.
2254	do	24	71.3											Meat diet	Do.
2255	do	24												Mixed diet	Do.
2256	Watchmaker	28	70	1,698.4	2,301.4	—603.0	115.1	221.5	—106.4	17.6	19.7	0.0	— 2.1	No food. No work	Pettenkofer and Voit.
2257	do	28		1,626.3	2,004.2	—337.9	110.7	188.2	— 77.5	16.0	18.9	0.0	— 2.9	do	Do.
2258	do	28		2,837.9	3,106.1	—268.2	221.1	282.4	— 61.3	13.4	14.4	0.0	— 1.0	do	Do.
2259	do	28		2,712.9	2,630.2	+ 82.7	270.9	248.2	+ 32.7	23.9	18.1	5.9	— 0.1	Medium diet. No work	Do.

TABLE 26—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject.			Food per day.	Duration.	Nitrogen.				Carbon.				
		Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
2260	1866	Watchmaker	28	......	149.5 gm. meat, 59.2 gm. egg white, 450 gm. bread, 504.8 gm. milk, 984.4 gm. beer, 52 gm. fat, 30 gm. butter, 70 gm. starch, 17 gm. sugar, 2.9 gm. salt, 662.9 gm. water, 919.1 gm. oxygen from air.	1	19.5	16.3	2.7	+ 0.5	301.1	12.6	18.2	257.2	+ 13.1
2261	1866	.....do	28	......	160.1 gm. meat, 61.1 gm. egg white, 450 gm. bread, 506.9 gm. milk, 1,053 gm. beer, 46.7 gm. fat, 30 gm. butter, 70 gm. starch, 17 gm. sugar, 4.1 gm. salt, 48.8 gm. water, 866.9 gm. oxygen from air.	1	19.5	17.4	2.6	— 0.5	298.9	12.6	18.0	253.7	+ 14.6
2262	1866	.....do	28	......	128.8 gm. meat, 50.7 gm. egg white, 450 gm. bread, 500 gm. milk, 1,025 gm. beer, 70 gm. fat, 30 gm. butter, 70 gm. starch, 17 gm. sugar, 4.9 gm. salt, 963.2 gm. water, 953.9 gm. oxygen from air.	1	19.5	17.3	1.8	+ 0.4	315.5	12.4	12.1	350.2	— 59.2
2263	1866	.....do	28	......	151.3 gm. meat, 48.1 gm. egg white, 450 gm. bread, 500 gm. milk, 1,065.9 gm. beer, 60.2 gm. fat, 30 gm. butter, 70 gm. starch, 17 gm. sugar, 4.9 gm. salt, 480.1 gm. water, 1,006.1 gm. oxygen from air.	1	19.5	17.4	2.1	0.0	309.2	12.6	14.5	309.2	— 27.1
2264	1866	.....do	28	......	503.6 gm. meat, 153 gm. egg white, 510 gm. bread, 508 gm. milk, 2,757.8 gm. beer, 85.7 gm. fat, 30 gm. butter, 7.7 gm. salt, 850 gm. oxygen from air.	1	42.6	26.0	2.7	+13.9	430.9	17.4	18.3	273.6	+121.6
2265	1866	.....do	28	......	467.5 gm. meat, 169.5 gm. egg white, 510 gm. bread, 505.2 gm. milk, 2,756.7 gm. beer, 65.7 gm. fat, 30 gm. butter, 8.9 gm. salt, 876.1 gm. oxygen from air.	1	42.6	32.8	3.3	+ 6.5	415.3	22.0	22.8	283.1	+ 87.4
2266	1866	.....do	28	......	13.6 gm. meat extract, 400 gm. starch, 38.1 gm. sugar, 78.9 gm. fat, 11.9 gm. salt, 1,408 gm. water, 808 gm. oxygen from air.	1	1.3	12.9	0.5	—12.1	228.7	8.8	9.6	228.8	— 18.4
2267	1866	.....do	28	......	303.1 gm. meat, 500 gm. bread, 963.9 gm. beer, 43.7 gm. fat, 50 gm. butter, 5.4 gm. salt, 448 gm. water, 848.8 gm. oxygen from air.	1	24.6	18.1	1.8	+ 4.7	278.6	12.0	12.2	254.3	+ 0.1
2268	1866	Tailor	36	54	151.1 gm. meat, 61.8 gm. egg white, 450 gm. bread, 509.6 gm. milk, 1,012.7 gm. beer, 58.8 gm. fat, 30 gm. butter, 70 gm. starch, 17 gm. sugar, 4.3 gm. salt, 41.4 gm. water, 600.7 gm. oxygen from air.	1	19.5	18.0	2.1	— 0.6	307.4	12.7	14.6	189.6	+ 90.5
2269	1867	Peasant..........	21	54.4	35.9 gm. meat extract, 22.3 gm. salt, 2,590 gm. water, 344 gm. oxygen from air.	1	3.4	14.5	0.0	—11.1	7.0	32.6	0.0	136.9	—162.5

TABLE 26—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.			Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Occupation.	Age.	Weight.	In food.	Total excreted.	Gain (+) or loss (—).	In food.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Yrs.	*Kg.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
2260	Watchmaker	28	......	3, 248. 7	2, 652. 9	+595. 8	309. 7	248. 4	+ 61. 3	22. 9	18. 1	7. 4	— 2. 6	Medium diet. No work	Pettenkofer and Voit.
2261	.....do	28	......	2, 723. 0	2, 818. 3	— 95. 2	250. 1	270. 7	— 20. 6	23. 9	20. 5	7. 3	— 3. 9	.....do	Do.
2262	.....do	28	......	3, 558. 0	3, 815. 5	—257. 7	345. 9	362. 2	— 16. 2	24. 6	21. 2	4. 9	— 1. 5	Medium diet. Work	Do.
2263	.....do	28	......	3, 232. 5	3, 246. 5	— 14. 1	297. 7	304. 9	— 7. 2	24. 9	19. 4	5. 9	— 0. 4	.....do	Do.
2264	.....do	28	......	4, 416. 1	3, 535. 3	+880. 8	475. 5	355. 1	+120. 4	41. 1	26. 4	7. 4	+ 7. 3	Diet rich in protein. No work.	Do.
2265	.....do	28	......	4, 420. 3	4, 015. 2	+405. 1	470. 7	413. 2	+ 57. 5	43. 3	27. 3	9. 2	+ 6. 7	.....do	Do.
2266	.....do	28	......	2, 316. 5	2, 264. 1	+ 52. 4	197. 1	208. 3	— 11. 2	14. 9	13. 5	1. 9	— 0. 6	Diet without protein. No work.	Do.
2267	.....do	28	......	2, 598. 9	2, 709. 0	—110. 2	236. 9	256. 9	— 20. 0	25. 6	20. 0	4. 9	+ 0. 7	Abundant diet.	Do.
2268	Tailor	36	54	2, 410. 9	2, 315. 6	+ 95. 3	245. 4	228. 7	+ 16. 7	24. 1	18. 0	5. 9	+ 0. 2	Medium diet. No work.	Do.
2269	Peasant	21	54. 4	2, 661. 6	2, 210. 1	+451. 5	290. 3	230. 2	+ 60. 1	29. 9	11. 6	0. 0	+18. 3	Diabetes. No food	Do.

TABLE 26—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject.			Food per day.	Duration.	Nitrogen.				Carbon.				
		Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
2270	1867	Peasant	21	55.2	530.1 gm. meat, 744.7 gm. bread, 265.7 gm. butter, 107.5 gm. fat, 154.9 gm. egg white, 2,575 gm. milk, 25.2 gm. red bilberries, 13.8 gm. salt, 969 gm. beer, 6,416 gm. water, 792 gm. oxygen from air.	1	61.5	47.0	10.4	+ 4.1	798.4	302.0	88.8	222.5	+185.1
2271	1867	....do	21	54.7	150 gm. meat, 48.9 gm. egg white, 515 gm. milk, 450 gm. bread, 30 gm. butter, 70 gm. fat, 70 gm. starch, 17 gm. sugar, 2 gm salt, 1,025 gm. beer, 3,032.1 gm. water, 680.1 gm. oxygen from air.	1	19.6	22.4	4.3	— 7.2	318.4	195.0	29.6	184.5	— 90.7
2272	1867	....do	21	53.8	500 gm. starch, 100 gm. sugar, 105 gm. fat, 18 gm. red bilberries, 1,537.5 gm. beer, 3,344.2 gm. water, 591.9 gm. oxygen from air.	1	1.0	9.1	4.1	—12.2	351.6	175.4	78.0	173.4	— 75.2
2273	1867	....do	21	52.1	751.4 gm. meat, 80 gm. fat, 13.7 gm. salt, 3,000 gm. water, 613.5 gm. oxygen from air.	1	45.9	29.1	5.0	+11.8	232.2	72.0	37.2	171.6	— 48.6
2274	1867	....do	21	54.6	18.8 gm. salt, 128.3 gm. fat, 25 gm. red bilberries, 690.8 gm. meat, 272.9 gm. egg white, 1,030 gm. milk, 1,025 gm. beer, 5,705 gm. water.	1	54.1	46.4	4.9	+ 2.8	....	....	....	....	....
2275	1869	Man	40	59.7	142.1 gm. meat, 52.1 gm. egg white, 450 gm. bread, 500 gm. milk, 1,025 gm. beer, 70 gm. fat, 30 gm. butter, 70 gm. starch, 17 gm. sugar, 4.7 gm. salt, 294.5 gm. water, 789.8 gm. oxygen from air.	1	19.5	13.7	3.6	+ 2.2	317.3	11.4	24.7	264.6	+ 16.6
2276	1888	Man	......	47.5	500 gm. bread, 500 gm. potato, 400 gm. beef, 50 gm. cheese, 50 gm. butter, 50 gm. sugar, 600 cc. wine, 500 cc. coffee, 1,320 cc. water.	......	20.2	12.5	(2.7)	+ 4.7	268.9	6.0	30.0	208.0	+ 24.9
2277	......	Laboratory janitor (E. O.).	29	66.9	121 gm. cooked beef, 98 gm. egg, 35 gm. butter, 75 gm. cheese, 1,000 gm. milk, 100 gm. crackers, 250 gm. bread, 150 gm. boiled potato, 20 gm. sugar.	1	22.7	20.2	0.9	+ 1.6	289.3	11.7	9.0	216.5	+ 52.1
2278	......	....do	29	......	....do	1	22.7	19.0	0.9	+ 2.9	289.3	11.0	9.0	211.7	+ 57.6
2279	......	....do	29	......	......	......	22.7	19.6	0.9	+ 2.2	289.3	11.4	9.0	214.1	+ 57.5
2280	......	....do	29	......	121 gm. cooked beef, 101 gm. cooked egg, 20 gm. butter, 75 gm. cheese, 500 gm. milk, 100 gm. crackers, 250 gm. rye bread, 150 gm. boiled potato, 40 gm. sugar, 600 cc. coffee.	1	19.2	18.6	1.6	— 1.0	260.6	14.7	9.9	227.8	+ 8.2
2281	......	....do	29	......	....do	1	19.2	17.5	1.6	+ 0.1	260.6	13.9	9.9	207.3	+ 29.5
2282	......	....do	29	......	......	......	19.2	18.1	1.6	— 0.5	260.6	14.3	9.9	217.6	+ 18.8

TABLE 26—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.			Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Occupation.	Age.	Weight.	In food.	Total excreted.	Gain (+) or loss (—).	In food.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Yrs.	*Kg.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
2270	Peasant	21	55.2	10,398.2	11,835.3	—1,437.1	1,269.1	1,434.0	—164.9	66.6	35.7	30.8	+ 0.1	Diabetes. Abundant mixed diet.	Pettenkofer and Voit.
2271	....do	21	54.7	5,151.8	5,945.9	— 794.1	578.9	708.4	—129.5	23.1	18.3	11.9	— 7.1	Diabetes. Medium diet	Do.
2272	....do	21	53.8	5,243.8	6,401.2	—1,157.4	594.7	755.7	—161.0	5.4	10.0	15.7	—20.3	Diabetes. Diet without protein.	Do.
2273	....do	21	52.1	3,735.5	4,698.2	— 962.7	412.6	542.0	—129.4	32.2	24.5	21.0	—13.3	Diabetes. Diet without carbohydrates.	Do.
2274	....do	21	54.6							47.9	39.0	15.9	— 7.0	Diabetes. Diet rich in protein. but poor in carbohydrates.	Do.
2275	Man	40	59.7	2,811.3	3,230.8	— 419.5	272.7	318.6	— 45.9	24.4	16.5	10.0	— 2.1	Leucocythæmia	Do.
2276	Man		47.5												Hanriot and Richet.
2277	Laboratory janitor (E. O.).	29	66.9											No muscular work	Atwater, Woods, and Benedict.
2278	....do	29												....do	Do.
2279	....do	29												Average of Nos. 2277, 2278	Do.
2280	....do	29												No muscular work	Do.
2281	....do	29												....do	Do.
2282	....do	29												Average of Nos. 2280, 2281	Do.

TABLE 26—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject.			Food per day.	Duration.	Nitrogen.				Carbon.				
		Occupation.	Age.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
2283	......	Chemist (O. F. T.)	24	63.6	96 gm. beef, 100 gm. egg, 20 gm. butter, 660 gm. milk, 210 gm. pears (canned), 270 gm. potato, 275 gm. bread, 46 gm. sugar, 85 gm. apples, 140 gm. peaches (canned).	1	15.3	12.7	0.9	+1.7	234.3	8.7	6.9	220.9	— 2.2
2284	......	.....do	24	......	.....do	1	15.3	13.5	0.9	+0.9	234.3	9.9	6.9	215.3	+ 2.2
2285	......	.....do	24	......	.....do	1	15.3	13.6	0.9	+0.8	234.3	10.6	6.9	218.8	— 2.0
2286	......	.....do	24	......	.....do	1	15.3	13.7	0.9	+0.7	234.3	11.8	6.9	222.9	— 9.3
2287	......	.....do	24	......	.....do	1	15.3	15.2	0.9	—0.8	234.3	13.6	6.9	221.7	— 7.9
2288	......	.....do	24	......	......	......	15.3	13.7	0.9	+0.7	234.3	10.9	6.9	219.9	+ 3.6
2289	......	Physicist (A. W. S.).	22	76.4	94 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 587 gm. water.	1	16.2	14.1	1.4	+0.7	244.1	7.6	10.5	237.0	—11.0
2290	......	.....do	22	......	96 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 565 gm. water.	1	16.2	13.1	1.4	+1.7	244.1	5.9	10.5	244.3	—16.6
2291	......	.....do	22	......	Food as in No. 2294, with 660 gm. water	1	16.2	13.7	1.4	+1.1	244.1	8.9	10.5	231.6	— 6.9
2292	......	.....do	22	......	90 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 786 gm. water.	1	16.2	12.6	1.4	+2.2	244.1	11.5	10.5	220.7	+ 1.4
2293	......	.....do	22	......	......	......	16.2	13.4	1.4	+1.4	244.1	8.5	10.5	233.4	— 8.3
2294	......	.....do	22	......	100 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 828 gm. water.	1	16.2	11.9	1.4	+2.9	244.1	13.0	10.5	240.6	+20.0
2295	......	.....do	22	......	92 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 605 gm. water.	1	16.2	12.4	1.4	+2.4	244.1	8.4	10.5	229.4	— 4.2
2296	......	.....do	22	......	98 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 880 gm. water.	1	16.2	13.1	1.4	+1.7	244.1	10.8	10.5	243.2	—20.4
2297	......	.....do	22	......	......	......	16.2	12.5	1.4	+2.3	244.1	10.7	10.5	237.7	—14.8

TABLE 26—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.			Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Occupation.	Age.	Weight.	In food.	Total excreted.	Gain (+) or loss (−).	In food.	Total excreted.	Gain (+) or loss (−).	In food.	In urine.	In feces.	Gain (+) or loss (−).		
		Yrs.	Kg.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.		
2283	Chemist (O. F. T.)	24	63.6	......	......	......	......	......	......	......	......	......	......	No muscular work	Atwater, Woods, and Benedict.
2284	....do	24	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2285	....do	24	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2286	....do	24	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2287	....do	24	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2288	....do	24	......	......	......	......	......	......	......	......	......	......	......	Average of Nos. 2283–2287	Do.
2289	Physicist (A. W. S.).	22	76.4	......	......	......	......	......	......	......	......	......	......	No work	Do.
2290	....do	22	......	......	......	......	......	......	......	......	......	......	......	Mental work	Do.
2291	....do	22	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2292	....do	22	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2293	....do	22	......	......	......	......	......	......	......	......	......	......	......	Average of Nos. 2290–2292	Do.
2294	....do	22	......	......	......	......	......	......	......	......	......	......	......	No work	Do.
2295	....do	22	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2296	....do	22	......	......	......	......	......	......	......	......	......	......	......	....do	Do.
2297	....do	22	......	......	......	......	......	......	......	......	......	......	......	Average of Nos. 2294–2296	Do.

TABLE 26—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject. Occupation.	Subject. Age.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Carbon. In food.	Carbon. In urine.	Carbon. In feces.	Carbon. In respiratory products.	Carbon. Gain (+) or loss (—).
			Years.	*Kg.*		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
2298	......	Physicist (A. W. S.).	22	......	104 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 1,425 gm. water.	1	16.2	11.7	1.4	+3.1	244.1	8.7	10.5	348.0	—123.1
2299	......	.....do	22	......	98 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 1,301 gm. water.	1	16.2	16.4	1.4	—1.6	244.1	11.0	10.5	384.8	—162.2
2300	......	.....do	22	......	100 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 1,521 gm. water.	1	16.2	14.3	1.4	+0.5	244.1	10.4	10.5	381.8	—158.6
2301	......	.....do	22	......	......	......	16.2	14.1	1.4	+0.7	244.1	10.0	10.5	371.5	—147.9
2302	......	.....do	22	......	90 gm. cooked beef, 45 gm. butter, 650 gm. milk, 150 gm. wheat bread, 250 gm. brown bread, 40 gm. oatmeal, 120 gm. beans, 100 gm. potato, 125 gm. apples, 20 gm. sugar, 993 gm. water.	1	16.2	16.1	1.4	—1.3	244.1	11.2	10.5	242.7	— 20.3
2303	......	Laboratory janitor (E. O.).	29	......	120 gm. fried beef, 25 gm. dried beef, 95 gm. eggs, 35 gm. butter, 775 gm. milk, 325 gm. rye bread, 125 gm. baked beans, 150 gm. canned pears, 35 gm. sugar.	1	19.1	20.3	1.6	—2.8	237.3	13.0	13.8	237.6	— 27.1
2304	......	.....do	29	......	.....do	1	19.0	17.4	1.7	—0.1	237.3	11.2	13.8	234.7	— 22.4
2305	......	.....do	29	......	.....do	1	19.1	17.2	1.6	+0.3	237.3	11.1	13.8	218.8	— 6.4
2306	......	.....do	29	......	.....do	1	19.0	17.4	1.7	—0.1	237.3	11.3	13.8	235.7	— 23.5

TABLE 26—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.			Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Occupation.	Age.	Weight.	In food.	Total ex creted.	Gain (+) or loss (—).	In food.	Total ex-creted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Yrs.	*Kg.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
2298	Physicist (A. W. S.).	22												Muscular work	Atwater, Woods, and Benedict.
2299	do	22												do	Do.
2300	do	22												do	Do.
2301	do	22												Average of Nos. 2298–2300	Do.
2302	do	22												No work	Do.
2303	Laboratory janitor (E. O.).	29												do	Atwater, Benedict, and Rosa.
2304	do	29												do	Do.
2305	do	29												do	Do.
2306	do	29												do	Do.

Nos. 2242–2246. Ann. Chim. Phys., ser. 3, 25, p. 140. Nos. 2247, 2248. Die normal Diet, p. 72. No. 2249. Ibid., p. 31. No. 2250. Arch. Anat. und Physiol., 1862, p. 340. No. 2251. Ibid., p. 337. No. 2252. Ibid., p. 341. No. 2253. Ibid., p. 356. No. 2254. Ibid., p. 347. No. 2255. Die Ernährung des Menschen, p. 195. No. 2256. Ztschr. Biol., 2, p. 478. No. 2257. Ibid., p. 483. No. 2258. Ibid., p. 486. No. 2259. Ibid., p. 490. No. 2260. Ibid., p. 492. No. 2261. Ibid., p. 495. No. 2262. Ibid., p. 497. No. 2263. Ibid., p. 500. No. 2264. Ibid., p. 502. No. 2265. Ibid., p. 505. No. 2266. Ibid., p. 507. No. 2267. Ibid., p. 511. No. 2268. Ibid., p. 514. Nos. 2269–2274. Ibid., 3, p. 384. No. 2275. Ibid., 5, p. 322. No. 2276. Compt. Rend. Acad. Sci., Paris, 106, p. 420. Nos. 2277–2302. U. S. Dept. Agr., Office of Experiment Stations Bul. 44, pp. 44, 47, 50, 55. Nos. 2303–2306. Unpublished material.

Nos. 2242–2246 were made by Barral, in Paris, in 1847 and 1848. The objects were an investigation of the rôle of salt in the organism and a study of the metabolic balance. The former point will not be discussed in this abstract. The author believed that, the amount and elementary composition of the liquid and solid matter consumed daily being known, it was necessary also to determine the amount and elementary composition of the excreta (including respiratory products) in order to make a comparison of the income and outgo of the organism.

The subjects were the investigator, his young son, a laboratory servant, and a young woman. The food in these experiments consisted of a mixed diet, which included meat, bread, butter, milk, potatoes, etc. The greatest care was used in the preparation of the food. The food and drink, urine, and feces were weighed and the total solids, the water, carbon, nitrogen, hydrogen, oxygen, chlorin, and ash in each were determined by analysis. The methods followed in determining mineral matter and water were essentially the same as now used. The carbon, nitrogen, hydrogen, and oxygen appear to have been determined by combustion, though the fact is not stated. The respiratory products, perspiration, and inspired air were not measured or analyzed. The amount of water excreted in the respiratory products and perspiration was calculated from the excess of oxygen and hydrogen consumed over that excreted in urine and feces. The carbon dioxid in the respiratory products was computed from the similar excess of carbon. The excess of nitrogen consumed over that in the urine and feces was supposed to be excreted in the perspiration and respiratory products. These experiments were made in winter and summer in order to eliminate the variation, if any, due to temperature.

In all of Barral's experiments the income of nitrogen was considerably greater than the outgo in the urine and feces. This excess he considered to be a respiratory product, and his work is often cited in proof of the theory of the respiratory excretion of nitrogen. In examining Barral's figures, before inserting them in the present compilation, the nitrogen in the meat, as given by him, was multiplied by 6.25, the protein factor ordinarily accepted. In almost every case the protein thus obtained was equal to or greater than the total meat as given by Barral. Since all meat contains water and fat as well as protein, Barral's figures for consumed nitrogen are evidently too high. The total nitrogen in the meat in the 5 days of No. 2242, for instance, as given by Barral, is 85.9 grams. The amount obtained, if König's figures are used to compute it, is 68.1 grams. In the case of bread, butter, milk, cheese, etc., there is almost no variation between the amounts Barral gives and those which would be obtained by computation with the aid of König's figures. It is evident that no conclusions regarding respiratory nitrogen can be drawn from these experiments, since the consumed nitrogen, as given by the author, is much too high.

An interesting conclusion reached by the author is that a man radiates 30,000 units of heat per day in summer and 42,000 units per day in winter. These values were obtained by calculation.

Barral's work is interesting to-day from an historical standpoint. It is the first attempt which has been found by the compilers to determine the complete metabolic balance of matter for man in terms of the elements. It is not surprising that errors in the analytical work should be found, for methods of analysis were not perfected when this work was done.

An extended historical account of views regarding metabolism of man and animals is included in Barral's work.

Nos. 2247–2249 were reported by Hildesheim in 1856 and form part of an extended study of the problems relating to the food of man. It would seem that part of the figures in Nos. 2247 and 2248 were obtained from actual experiments, and the rest obtained by the author from calculations based on available data. No. 2249 is the result of calculations based on Barral's and similar work. The subject of Nos. 2247 and 2248 was a soldier. The diet consisted of bread, meat, butter, peas, etc., in both cases and was somewhat more abundant in the latter. In the author's opinion nitrogen was excreted in the respiratory products and perspiration, and in all

the experiments the calculated values for such excretion are included, the amount being equal to the excess of consumed nitrogen over that excreted in the urine and feces. In No. 2247 the diet was considered insufficient, and it was the author's opinion that some of the muscular tissue of the organism was metabolized. The amount and its composition was calculated. In No. 2249 the daily excretions of a healthy man are calculated as well as the diet which would suffice to cover the outgo. The figures are included here because they are referred to by Voit in discussing the probability of a respiratory excretion of nitrogen. Although the author believes in the possibility of respiratory nitrogen, yet the amount he considers to be excreted in this way is very small, namely, 0.015 gram out of a total of 18.094 grams consumed. The nitrogen excreted through the skin is given at 1.399 grams, or 8 per cent of the total.

The author made calculations similar to No. 2249 for a man on a vegetable diet, on a diet of animal food, fasting, etc. In these approximations the composition of the food was calculated from analyses made by Bidder and Schmidt, Berzelius, Playfair, Boussingault, etc. These approximations all include calculations for the balance of nitrogen, carbon, water, hydrogen, oxygen, and ash. It is noticeable that the factor which must be used to reduce nitrogen to protein is not the same in every case.

Hildesheim's publication is a very complete compendium of early analytical data.

Nos. 2250–2255 and Nos. 398–406, Table 7, were made by Ranke in the laboratory of the Physiological Institute in Munich in 1862, to study the metabolism of nitrogen and carbon in man under various dietary conditions. The investigator was himself the subject. In Nos. 2250–2252 he was fasting; in Nos. 2254, 405, and 406 the diet consisted of meat and fat, and in Nos. 2255 and 398–403 a mixed diet was followed. The food, urine, and feces were analyzed. In the experiments in which the respiratory products were measured the apparatus and experimental methods of Pettenkofer and Voit were used. Ranke was the first person to enter the Pettenkofer respiration apparatus for experimental purposes.

Among the principal conclusions reached were the following: It is possible to so arrange a mixed diet that the daily excretion of nitrogen in the urine and feces will just equal the amount consumed; but nitrogen equilibrium is not reached unless the food contains sufficient carbon as well as nitrogen. A constant ratio between the nitrogen and carbon in the food is not necessary for nitrogen equilibrium. When the food is insufficient the excretion of nitrogen in the urine and feces is greater than the amount consumed, and this would be the case whether nitrogen or carbon were lacking in the food. When fasting the nitrogen excretion diminishes more rapidly than the carbon excretion.

On a diet of meat and fat the subject lost weight. This diet did not supply sufficient carbon. Consuming large quantities of meat caused digestive disturbances. When the diet contained no protein the amount of nitrogen excreted in the urine was somewhat less than during fasting. This diet only slightly increased the excretion of carbon. The weight of the body is not a direct measure of its condition as regards nutrition, owing to the fact that more or less water is contained in the tissues at different times. The experiments and the deductions drawn from them are discussed at length both in the publication cited and in a later publication.[1]

Nos. 2256–2268 were made by Pettenkofer and Voit in the laboratory of the Physiological Institute in Munich in 1866–67. The Pettenkofer respiration apparatus was employed. The experiments form one of the most extended and important series of their kind yet published. The nitrogen, carbon, hydrogen, and oxygen, and the water, protein, fats, carbohydrates, and ash of the income and outgo were either determined or estimated. Twelve tests with a watchmaker (Nos. 2256–2267) and 1 with a tailor (No. 2268) are reported.

The watchmaker was a strong, healthy man. The tailor was not robust. The tests each lasted 24 hours.

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[1] Ranke, Die Ernahrung des Menschen, Munich, 1876.

In Nos. 2256–2258 no food was consumed and no work was done. A little meat extract was taken as a stimulant. In Nos. 5259–2261 the diet was moderate (*mittlere Kost*) and no work was done. In Nos. 2262 and 2263 the same diet was followed but muscular work was performed. In Nos. 2264 and 2265 a dietary rich in protein was followed and no work was done. In No. 2266 a diet which contained no protein was consumed and no work was performed. In No. 2267 the diet was abundant. It was divided into two parts, and half was consumed during the day and half during the night. In No. 2268 the diet was medium (*mittlere Kost*) and no work was done.

On the days in which the watchmaker did no muscular work he passed the time in reading, cleaning a watch, or other light occupation. The muscular work performed consisted of turning a lathe, and was rather severe.

The food consumed was very carefully prepared, only such articles being used as were believed to have a known, uniform composition. The meat used was beef, which was prepared in Voit's customary way. All visible fat, connective tissue, etc., were removed with scissors, and only what was considered to be pure muscle was retained. This meat was weighed, then fried in a known quantity of fat, and again weighed, the loss in weight being calculated as water. The milk used was always from the same cow, the cow being kept on a uniform diet.

White of egg was either fried in a little fat or made into a sort of cake with starch, sugar, and a little fat. Soup was made from South American meat extract (presumably Liebig's), salt, and water. It took the entire time of one man to prepare, weigh, and cook the required amount of food. Analyses of these various foods were not made—the composition was assumed from earlier analyses. The following table gives the values which were used:

Assumed composition of food materials.

Food materials.	Water-free substance.	In water-free substance.					
		Water.	Carbon.	Hydrogen.	Nitrogen.	Oxygen.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Lean beef (muscle nearly free from fat)	24.10	75.90	12.52	1.73	3.40	5.15	1.30
White of egg	13.32	86.68	7.13	0.96	1.93	2.89	0.41
Bread	53.65	46.35	24.37	3.46	1.28	22.33	2.21
Milk	12.92	87.08	7.05	1.11	0.63	3.40	0.73
Butter	92.95	7.05	73.43	10.23	0.11	9.30	....
Fat	....	....	76.50	11.90	....	11.60	....
Starch	84.21	15.79	37.42	5.21	....	41.58	....
Sugar	....	....	42.10	6.43	....	51.46	....
Meat extract	68.22	31.78	19.50	3.90	9.47	16.16	19.19
Beer	6.22	93.78	2.49	0.42	0.07	2.98	0.27
Salt	98.19	1.81	....	....	....	....	98.19
Water	0.04	99.96	....	....	....	....	0.04

The fact that the various articles of food were not analyzed is one of the weak points in this investigation, for it has seemed to many critics that the analyses Voit depended upon in computing the composition of the food were not sufficiently accurate. It was Voit's belief, however, that he and Pettenkofer actually succeeded in preparing a diet which was practically unvarying, for under similar conditions the following quantities of carbon dioxid and urea were excreted during equal periods of time: In the breath 912, 943, and 930 grams of carbon dioxid, and in the urine 37.2, 35.4, and 37.3 grams of urea.

The nitrogen in the urine was calculated from the amount of urea as determined by the Liebig titration method. The accuracy of the results is shown by Pettenkofer and Voit in the following table, which gives the amount of nitrogen found by

this method and by elementary analysis of a considerable number of the specimens collected during the experiments:

Comparison of two methods of determining nitrogen.

Date.	Day or night.	Amount of urine.	Nitrogen calculated from urea.	Nitrogen by elementary analysis.
1866–67.		*Grams.*	*Grams.*	*Grams.*
July 7	Day	846	10.03	10.12
Do	Night	497	7.33	7.24
August 3	Day	726	9.38	9.41
Do	Night	451	7.56	7.85
December 11	Day	855	7.42	6.97
December 22	do	477	5.55	5.91
Do	Night	315	6.11	6.35
December 27	Day	723	8.96	8.22
Do	Night	644	8.40	8.52
December 29	Day	653	8.82	8.49
Do	Night	608	8.59	8.39
January 2	Day	822	10.83	10.50
Do	Night	1,160	15.21	15.50
January 4	Day	860	14.61	14.90
Do	Night	1,464	17.92	17.40
January 7	Day	554	7.70	7.43
Do	Night	331	5.23	5.13

The solid matter in the urine was determined by evaporating portions to dryness with quartz sand. The ash was usually determined by extracting a weighed portion of charred solid matter with hydrochloric acid until the weight was constant. Sometimes, however, the charred mass was extracted with water, then burned in a crucible until white, the water being added again, evaporated to dryness, and the total residue weighed. Carbon and hydrogen were determined in a number of cases by elementary analysis. This would also give oxygen by difference. The oxygen and hydrogen computed from the water of the fresh sample were added to these values to give the total consumed. It may be inferred, though it is not directly stated by the authors, that complete analyses of the urine were not made for each day of the experiments, but that the composition of urine from medium diet was determined, and this assumed to be constant. Determinations of uric, sulphuric, and phosphoric acids were also made in some cases. Usually each day the total urine and its content of dry matter, ash, and sodium chlorid seem to have been all that was actually determined.

The feces were collected each morning, it being assumed that the feces of a particular morning were due to the food consumed the preceding day. No charcoal, milk, or other material was used to make a separation. The descriptions seem to imply that the feces were analyzed once for all, and that the only determinations made each day were the total weight, dry matter, and fat.

The subject was weighed at the beginning and end of each experiment. The bedclothing was also weighed night and morning, as it would absorb more or less perspiration.

The respiratory products were measured by means of the large Pettenkofer respiration apparatus. This has been described in detail in a previous publication of this Office.[1]

Determinations of the volumes of air which left the respiration chamber were made, and of the carbon dioxid, water, and methan and hydrogen which this air contained. The carbon dioxid and water in the air which entered the respiration chamber were also determined.

The main current of air was drawn from near the bottom and top of the respira-

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 107.

tion chamber by means of a pair of large (valve) air pumps. It passed first through a large vessel containing pumice stone and water, in order that it might be saturated with moisture and not absorb any from the large meter through which it was next drawn to measure its volume. The air finally escaped through the air pumps. The volume was 250 to 1,250 liters per minute. The gasometer was believed to be correct to 1 part in 1,000.

Sample currents for analyses were drawn from the outside air close to where it entered the respiration chamber, and from the large pipe just after leaving the respiration chamber, in order to obtain as fair samples as possible of the air before and after passing through the chamber. These sample currents first passed through modified Liebig bulbs containing sulphuric acid, and a tube filled with pumice stone and sulphuric acid, to absorb and measure the water. The air then passed through a mercury pump, then through U-tubes containing water and pumice stone, in order that it might be saturated with water and not take up any from the solution of barium hydroxid through which it next passed, in order to absorb the carbon dioxid. The barium hydroxid solution was contained in two Pettenkofer tubes. The air finally escaped after passing through a small gasometer. These sample currents measured 80 to 90 cubic centimeters per minute; that is, about $\frac{1}{3000}$ or less of the respiratory current. The error in the measurement of this gasometer was believed to be about 1 in 1,000. The first Pettenkofer tube contained barium hydroxid solution, of which 30 cubic centimeters were equivalent to 90 milligrams carbon dioxid, the second a solution of which 30 cubic centimeters were equivalent to 30 milligrams carbon dioxid. The solutions were titrated with oxalic acid at the end of the experiment, to measure the quantity of barium hydroxid not combined with carbon dioxid. Tumeric paper was used as an indicator. The error in titration was less than $\frac{1}{10}$ milligram carbon dioxid. The error in measuring the total carbon dioxid produced in the chamber was assumed to be less than one-half of 1 per cent of the whole, while it was thought that the error in determining the water might be as much as 6 per cent.

"The oxygen consumed from the air was calculated by taking the weight of the income of food and drink from that of the outgo of urine, feces and respiratory products (CO_2 and H_2O) and then substracting the loss or adding the gain in weight of the body. The error is believed to be not more than 8.5 per cent of the total oxygen."

To determine the hydrogen and methan in the respired air a second sample was taken as before, but previous to its passing through the sulphuric acid bulbs and barium hydroxid tubes it was passed through a long tube containing red-hot platinum sponge. The hydrogen and methan would thus be burned to carbon dioxid and water. From the excess of carbon dioxid and water in this sample over the air which was not passed over the platinum sponge the amount of methan and hydrogen was calculated.

Nos. 2269–2274 were made by Pettenkofer and Voit at Munich in 1865–66. The large respiration apparatus was used. The subject was a peasant who had been accustomed to work in the fields. For some time before the investigation he had been unable to work much, but had an unusually good appetite. A difficulty of the eyesight brought him to the notice of the physicians, and it was then found that he was suffering from diabetes mellitus. The analytical methods and details of the experiments were the same as those in Nos. 2256–2268.

The diet consisted of bread, meat, etc. In No. 2269 no food was consumed. A little bouillon made from beef extract was, however, taken. In No. 2270 the diet was mixed and very abundant. In No. 2271 the diet was medium (*mittlere Kost.*) In No. 2272 the diet contained no protein, and in No. 2273 no carbohydrates. No. 2274 was not a respiration experiment. The diet was rich in protein and poor in carbohydrates.

From these experiments the authors conclude that in cases of diabetes the amount of protein and fat metabolized is abnormally large. Thus, in No. 2269, with no food, the subject, who weighed about 54 kilograms, lost nitrogen which was the equiva-

lent of 326 grams of muscular tissue. Under similar conditions, in No. 2256, the healthy subject, weighing 70 kilograms, lost nitrogen which was equivalent to the same amount of muscular tissue. Ranke (No. 2250) lost nitrogen equivalent to 262 grams, and the healthy but poorly nourished tailor (No. 2268), weighing 54 kilograms, lost nitrogen equivalent to 287 grams muscular tissue.

The mixed diet which was sufficient for the laboring man weighing 70 kilograms (No. 2262) was not sufficient for the subject with diabetes. He still drew upon the fat and protein of his body.

It was only when the amount of protein consumed was very large, as in Nos. 2273 and 2274, that the income of nitrogen was equal to the outgo.

The authors also thought that the diseased organism took less oxygen from the air and excreted less carbon dioxid than the normal. Sugar was thought to be a decomposition product of the protein. Sugar thus produced, as well as that consumed in the food, could not be burned to carbon dioxid and water, as in a normal organism, owing to the insufficient amount of oxygen. That is, in cases of diabetes it was believed that there was a disturbance of the relation between the consumption of oxygen and the amount of combustion.

Voit[1] did not hold this idea very long, for he found that under certain conditions a person with diabetes could take as much oxygen from the air as a normal individual, and that the taking of oxygen from the air was a secondary process to combustion in the organism.

At this time Voit held the opinion that possibly all the quantitative changes in the metabolism of a person having diabetes could be explained on the ground that sugar was no longer a nutrient. A healthy laborer who holds his own with a mixed diet would certainly lose protein and fat if carbohydrates equivalent to the sugar excreted by a person with diabetes were removed from his diet.[2]

No. 2275 was made by Pettenkofer and Voit in the Munich laboratory in 1866. The subject was a man suffering from leucocythæmia, a disease characterized by an increase in the number of white corpuscles and a decrease in the number of red corpuscles of the blood.

After a considerable number of experiments with healthy individuals had been made it seemed desirable to the authors to study metabolism under the abnormal conditions of disease, hence this experiment and Nos. 2269–2274 were made.

The large respiration apparatus was used, and all details of manipulation were the same as in Nos. 2256–2268. A medium diet was followed, consisting of bread, meat, milk, beer, etc. No muscular work was done.

The conclusion is reached that the subject could utilize as much oxygen as a normal individual under the same conditions.

The authors do not go so far as to say that the red corpuscles of the blood do not unite with the oxygen of the air, or that the white corpuscles do this as well as the red. They would rather emphasize the fact that the organism possesses a remarkable power of accommodation in carrying on its functions normally under disturbing conditions.

No. 2276 was made by Hanriot and Richet in Paris in 1888. Considerable work has been done by these investigators. In most cases the object sought was the respiratory quotient, i. e., the relation of expired carbon dioxid to inspired oxygen. The experiment quoted in the present compilation was described with very few details.[3] A natural inference seems to be that the subject was not confined in a respiration chamber, but wore a sort of mouthpiece or mask, through which air was inspired and expired, the nostrils being closed. The apparatus was provided with a valve so that the inspired and expired air would always take the same course.

The inspired air passed through a gas meter of such accuracy that the total error

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[1] Hermann's Handbuch der Physiologie, VI, p. 227.

[2] Ibid., p. 226.

[3] Compt. Rend. Acad. Sci. Paris, 104 (1887), pp. 435 and 1327; 105 (1887), p. 76.

in measuring the air was believed not to exceed 50 cubic centimeters. After passing through the lungs it was expired and passed through a wash bottle which contained a very little water. The air was thus cooled. It next passed through a second gas meter, and then through a tube 1.5 meters long, which was filled with broken glass, over which a spray or shower of potassium hydroxid solution was continually falling. This absorbed most of the carbon dioxid. The little which remained was absorbed in a solution of barium hydroxid, through which the air next passed on its way to a third gas meter. The difference in volume of the air which passed through the first meter and the third meter evidently represents the amount of oxygen consumed from the air (provided it all combined with oxygen and was excreted as carbon dioxid). The difference between the volume of the air which passed through the second and third meters showed the amount of carbon dioxid produced.

This method seems to be very well adapted to certain lines of investigation. It is evident that the value of the work depends entirely upon the accuracy of the gas meters and the completeness of the absorption of carbon dioxid. In 10 experiments by the authors in which a known quantity of carbon dioxid made from marble was passed with a large quantity of air through the absorbers the smallest error was 0 per cent and the largest 2.58 per cent. In the latter case the amount of carbon dioxid was 6,800 cubic centimeters and the amount of air 150 liters. The gas meters were especially constructed and were believed to be very accurate.

In this experiment the food consisted of beef, bread, potatoes, cheese, etc. This diet was followed for 15 days. It is not stated that the food was analyzed. The carbon in the urine and feces was calculated. The nitrogen in the urine was determined. The authors assumed that no nitrogen is excreted in the feces.[1] In inserting the experiment in the present compilation, however, the amount of nitrogen in the feces found in No. 2260, where the food was similar, was inserted.

Nos. 2277–2302 were made by Atwater, Woods, and Benedict at Wesleyan University in 1895. The experiments were carried on by the Storrs Agricultural Experiment Station in cooperation with the United States Department of Agriculture and Wesleyan University. The object was to study the metabolism of matter and energy in man. In connection with the experiments the apparatus used was modified and improved and experimental methods were elaborated. The results are regarded as preliminary.

The subjects were a laboratory janitor, a chemist, and a physicist—all young men in good health. The food consisted of a simple mixed diet, which was in every case selected in accordance with the dietary habits of the subjects. A respiration apparatus of special construction was used. It is similar to that of Pettenkofer and Voit, with the addition of apparatus for measuring the energy liberated by the body in the form of heat. The inside measurements of the respiration chamber are, length 2.15 meters, width 1.22 meters, and height 1.92 meters. It is provided with conveniences for sitting, sleeping, eating, and working, as well as arrangements for ventilation and for the study of the respiratory products. The chamber consists, in fact, of three concentric boxes, the inner one of metal and the two outer ones of wood. The inner box is double walled, the inner wall being of sheet copper, the outer of sheet zinc. The two walls are 8 centimeters apart. This double-walled box is held in shape by a wooden framework between the two metal walls. The four vertical corners are rounded, as this simplifies the construction and makes the apparatus rather more convenient for use. The inside volume is approximately 4.8 cubic meters.

An opening in the front end of the metal chamber 70 centimeters high and 49 centimeters wide serves both the purpose of a window and a door for entrance and exit. This is hermetically closed with a pane of glass secured in a wooden frame with putty.

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[1] Compt. Rend. Acad. Sci. Paris, 106 (1888), p. 420.

A current of air is pumped through the apparatus and measured by special devices. Samples of the incoming and outgoing air were taken for analysis. An inconvenient rise in temperature is prevented by a current of cold water which passes through a system of pipes inside of the chamber. This device forms a part of the arrangements for measuring the heat given off from the body. It is desirable to have the incoming current of air as dry as possible. To reduce the water content to a minimum the air which came from out of doors was dried before it entered the chamber by surrounding a portion of the pipe through which it passed with a freezing mixture of salt and ice. The bulk of the water in the incoming air was thus removed and was weighed. The amount of water remaining in the incoming air and that in the outgoing air was determined by passing the samples through U tubes filled with pumice saturated with concentrated sulphuric acid. The carbon dioxid in the samples of air was determined by passing it through U tubes filled with soda lime. A U tube containing glass beads drenched with barium hydroxid solution was also used as a control. The experiments, together with the apparatus used and methods followed, are described in detail in Bulletin 44 of this Office and Connecticut Storrs Station Report for 1896.

Full analyses were made of the food and excretory products. The determinations of the balance of energy and hydrogen are not yet published.

In Nos. 2277–2279, with the janitor, the diet was rich in protein. No work was performed. The organism stored protein and fat. In Nos. 2280–2282, with the same subject, the diet was similar but less abundant. In this case the organism was very nearly in equilibrium. There was a small loss of protein and a small gain of fat.

The diet of the chemist (Nos. 2283–2288) was somewhat less abundant than in the preceding cases. The body was very nearly in nitrogen and carbon equilibrium, though there was a small gain of protein and loss of fat. No muscular work was performed.

The fourth experiment was divided into five periods (Nos. 2289–2302). In the first, third, and fifth periods no work was performed. During the second period the subject was engaged in severe mental work, consisting in part of mathematical calculations. In the fourth period severe muscular work (raising and lowering a weight) was performed. In all the periods there was a loss of fat and a slight loss of protein. When muscular work was performed the loss of fat was much greater than in the other cases. So far as could be observed mental work did not influence the metabolism of nitrogen and carbon.

In these experiments the subjects remained in the respiration chamber for comparatively long periods, yet no inconvenience was experienced. They were supplied with from 49 to 55 liters, and in one instance 75 liters, of air per minute. It is ordinarily assumed that the maximum amount of carbon dioxid permissible in the air of inhabited rooms should be about 2 milligrams of carbon dioxid per liter. In these experiments the air in the respiration chamber contained on an average 10 to 12 milligrams of carbon dioxid per liter, and during periods of severe muscular work the carbon dioxid rose to 24.6 milligrams per liter, yet no inconvenience was experienced. In the authors' opinion this would indicate that the discomfort experienced in poorly ventilated rooms is not due to an excess of carbon dioxid.

The lag in the excretion of nitrogen in the urine and the gain or loss of fat are discussed at considerable length.

Nos. 2303–2306 were made in 1897 at Middletown, Conn., by Atwater, Rosa, and Benedict, with the apparatus described in the preceding series. The subject was the laboratory janitor mentioned above. The respiration calorimeter had been somewhat modified. The details have, however, not been published. In connection with the series here reported, and other unpublished experiments, check experiments were made in which alcohol was burned in the respiration chamber. In these experiments, in addition to measuring the carbon and hydrogen produced, the heat was also measured.

In each case the alcohol was burned for a time, generally from three to six hours,

before the experiment proper began, the object being to get the temperature of the interior of the apparatus, the moisture content of the air, and the moisture adhering to the inner walls and the heat absorbers, as nearly as practicable, in equilibrium. The attempt was made to have the temperature and moisture content of the air during the last three to six hours of the experiment the same as in this preliminary period, on the assumption that under these conditions the amounts of moisture in the apparatus would be the same at both times. The quantities of water and carbon dioxid in the air at the beginning and at the end of the experiment were determined in samples of about 10 liters drawn out for the purpose.

The apparatus and the conditions of the experiment were such as to permit reasonable uniformity in the flow of the ventilating current of air through the chamber, the rate of combustion of alcohol, the consequent production of carbon dioxid, water, vapor, and heat, and the temperature of the interior of the chamber. The following figures show the results of determinations of the total amounts of carbon dioxid, water, and heat produced, compared with the theoretical amounts:

Summary of results of alcohol check experiments.

No. of experiment.	Date.	Duration.		Alcohol burned.	Carbon dioxid.		Water.		Heat.	
					Required.	Found.	Required.	Found.	Required.	Found.
		h.	*m.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*	*Cals.*
1	Apr. 27-29, 1897..	52	30	955.4	1,659.0	1,657.7	1,106.4	1,109.6	5,499.9	5,380.1
2	May 10-11, 1897..	29	56	798.8	1,387.5	1,385.5	924.8	925.6	4,556.6	4,558.8
3	May 26-27, 1897..	33	50	505.4	877.6	882.9	585.3	*a* 649.7	*a* 2,882.9	2,808.5
4	Nov. 2-3, 1897....	35	09	788.2	1,366.6	1,374.6	912,4	920.9	4,488.1	4,478.8

a The excess of water and deficiency of heat are assumed to be due to evaporation of water inside the chamber.

Considered as results of analyses and of determinations of the heat of combustion of ethyl alcohol the figures for experiments 1, 2, and 4 would compare with the theoretical figures as follows:

Determinations of respiration calorimeter compared with theoretical figures for carbon and hydrogen and heat of combustion of alcohol.

	Experiment 1.	Experiment 2.	Experiment 4.	Average.	Theoretical.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Carbon..................................	52.12	52.12	52.54	52.26	52.17
Hydrogen................................	13.08	13.05	13.16	13.10	13.04
Heat of combustion......................	98.70	100.00	99.80	99.50	100.00

The accuracy of the heat measurements of the respiration calorimeter was also tested by a number of experiments in which heat was given off by the use of an electric current, the amount being determined by the resistance. The tests by the electrical method showed much smaller variations from the theoretical standard than those made by the combustion of alcohol within the chamber, the widest variation being not more than one-half of 1 per cent.

EXPERIMENTS WITH ANIMALS.

Thirteen hundred and sixty-two experiments, or about one-third of the total number included in this compilation, were made with animals. Some 600 of these were made with animals such as are fed for economic purposes—cattle, sheep, swine, goats, and horses, about the same number with dogs, and a comparatively small number with doves and poultry. Generally speaking, the same methods were followed as in the experiments with man. Taking into account the very large number of feeding and digestion experiments with animals, the number in which the balance of income and outgo has been determined is surprisingly small. Very often the balance of income and outgo of nitrogen could have been determined with little additional labor. Except in a few instances, the animals used for experimental purposes were in normal health.

EXPERIMENTS IN WHICH THE NITROGEN BALANCE WAS DETERMINED.

In 1,156 of the experiments with animals the balance of income and outgo of nitrogen, with or without mineral matter, was determined. In the majority of cases with animals fed for economic purposes this balance was determined in connection with feeding and digestion experiments. A few experiments were, however, made for the study of special questions concerning metabolism. The majority of those for the study of the general laws of metabolism were made with dogs. They were used generally because of their fitness for experimental purposes. The range of size is such that a subject suited to a particular purpose may be readily selected. Dogs may be trained to eat almost any food for a longer or shorter period without serious inconvenience. A monotonous diet seldom causes lack of appetite, as in the case of man. The excretory products may be readily collected, and when confinement in a cage is a necessary experimental condition it has seldom proved so irksome as to derange normal functions.

In this compilation the material has been so arranged that the experiments with different kinds of animals are grouped in separate tables.

EXPERIMENTS WITH CATTLE.

INFLUENCE OF FEEDING.

In Table 27 are included 19 tests with cows and 121 with steers. The animals were all in health. In most cases the nitrogen balance was determined in connection with digestion and feeding experiments, and numerous special questions connected with the feeding and fattening of cattle were studied.

TABLE 27.—*Experiments with cattle. Influence of feeding.*

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. In milk.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2307	1839	Boussingault	Cow	....	15,000 gm. potatoes, 7,500 gm. rowen, 60,000 cc. water.	3	201.5	36.5	92.0	46.0	+27.0	Ash in food, 889.0 gm.; in urine, 384.2 gm.; in feces, 480.0 gm.; in milk, 56.4 gm.; loss 31.6 gm.
2308	1869	Voit	Cow	....	13,150 gm. hay, 2,453 gm. meal	6	241.5	93.7	96.0	48.9	+ 2.9	
2309	1869	Kühn and Fleischer.	Cow II	385.5	9,950 gm. meadow hay, 1,500 gm. bean meal	7	180.0	115.0		35.5	+29.5	
2310	1869	....do	Cow	....	7,680 gm. hay, 1,670 gm. starch	12	114.5	26.3	93.7		+ 2.5	
2311	1869	....do	....do	....	7,700 gm. hay, 1,110 gm. starch	17	114.8	22.8	85.6		+ 6.4	
2312	1870	Fleischer	Cow I	555.0	4,000 gm. meadow hay, 5,400 gm. barley straw, 2,000 gm. mangel-wurzel.	......	165.0	50.0	78.5	36.0	+ 0.5	
2313	1870	....do	Cow II	580.0	4,000 gm. meadow hay, 6,500 gm. barley straw, 1,750 gm. mangel-wurzel.	......	169.0	53.5	80.5	36.0	— 1.0	
2314	1871	Kühn and Fleischer.	Cow I	398.5	8,850 gm. meadow hay	6	120.5	88.5		33.5	— 1.5	
2315	1871	....do	Cow II	383.0	10,000 gm. meadow hay	5	121.0	85.0		32.5	+ 3.5	
2316	1871	....do	Cow I	403.5	9,950 gm. meadow hay, 1,000 gm. rape-seed meal (oil removed).	5	175.5	120.5		35.5	+19.5	
2317	1871	....do	Cow II	378.0	9,800 gm. meadow hay, 500 gm. rape-seed oil.	6	117.5	77.0		36.0	+ 4.5	
2318	1871	....do	Cow I	410.5	9,350 gm. meadow hay, 1,500 gm. starch	3	114.5	86.0		34.0	— 5.5	
2319	1871	....do	Cow II	381.5	9,400 gm. meadow hay, 1,400 gm. starch	6	115.0	75.0		33.5	+ 6.5	
2320	1871	....do	....do	386.5	9,850 gm. meadow hay	5	121.5	82.5		30.5	+ 8.5	
2321	1884	Sturtevant	Cow	....	27,400 gm. silage	3	267.6	161.5		83.0	+23.1	Average results for 4 cows.
2322	1891	Emery and Kilgore	Cow	....	5,914 gm. cotton-seed hulls	4	41.3	13.0	32.3	2.0	— 6.0	
2323	1891	....do	Cow	....	9,526 gm. cotton-seed hulls, 1,361 gm. cotton-seed meal.	4	153.7	51.0	85.6	3.0	+14.1	
2324	1893	Snyder	Cow	....	77,112 gm. pea silage, 27,216 gm. wheat bran.	5	241.2	126.1	48.1	46.3	+20.7	Ash in food, 677.7 gm.; in urine, 323.0 gm.; in feces, 261.3 gm.; in milk, 56.2 gm.; gain 37.2 gm.
2325	1893	....do	Cow	....	....do	5	241.2	122.5	47.2	59.0	+12.5	Ash in food, 677.7 gm.; in urine, 312.9 gm.; in feces, 244.0 gm.; in milk, 69.9 gm.; gain 50.9 gm.
2326	1860	Henneberg and associates.	Steer I	568.5	5,250 gm. clover hay, 6,300 gm. oat straw, 10,440 gm. mangel-wurzel, 5,500 gm. rape-seed cake, 250 gm. bean meal, 50 gm. salt, 32,800 cc. water.	3	174.5	90.0	81.5	......	+ 3.0	Ash in food, 980 gm.; in urine, 401 gm.; in feces, 555 gm.; gain, 24 gm.

2327	1860	.....do	Steer II............	562.3	4,445 gm. clover hay, 5,385 gm. oat straw, 9,050 gm. mangel-wurzel, 430 gm. rape-seed cake, 240 gm. bean meal, 50 gm. salt, 28,785 cc. water.	3	147.0	86.5	78.5	......	—17.0	Ash in food, 830 gm.; in urine, 353 gm.; in feces, 590 gm.; loss, 113 gm.
2328	1860	.....do	Steer I............	576.8	7,315 gm. oat straw, 27,355 gm. turnips, 50 gm. salt, 15,100 cc. water.	3	80.0	28.5	44.5	......	+ 7.0	Ash in food, 800 gm.; in urine, 457 gm.; in feces, 380 gm.; loss, 37 gm.
2329	1860	.....do	Steer II............	501.5	9,800 gm. clover hay, 50 gm. salt, 26,165 cc. water.	3	156.5	83.0	82.5	......	— 9.0	Ash in food, 735 gm.; in urine, 243 gm.; in feces, 820 gm.; loss, 128 gm.
2330	1860	.....do	Steer I............	587.0	7,375 gm. oat straw, 1,500 gm. turnips, 590 gm. rape-seed cake, 50 gm. salt, 24,150 cc. water.	3	85.5	30.0	34.5	......	+21.0	Ash in food, 705 gm.; in urine, 467.5 gm.; in feces, 375 gm.; loss, 137.5 gm.
2331	1860	.....do	Steer II............	534.5	6,960 gm. oat straw, 1,990 gm. clover hay, 298.5 gm. rape-seed cake, 50 gm. salt, 27,950 cc. water.	3	85.0	32.5	34.5	......	+18.0	Ash in food, 635 gm.; in urine, 326.5 gm.; in feces, 355 gm.; loss, 46.5 gm.
2332	1860	.....do	Steer I............	573.5	8,092.5 gm. oat straw, 1,500 gm. clover hay, 300 gm. rape-seed cake, 50 gm. salt, 33,765 cc. water.	3	83.5	34.0	42.5	......	+ 7.0	Ash in food, 685 gm.; in urine, 299.5 gm.; in feces, 330 gm.; gain, 55.5 gm.
2333	1860	.....do	Steer II............	524.0	6,992.5 gm. rye straw, 2,000 gm. clover hay, 300 gm. rape-seed cake, 50 gm. salt, 2,736.5 cc. water.	3	83.0	34.5	39.0	......	+ 9.5	Ash in food, 500 gm.; in urine, 137 gm.; in feces, 320 gm.; gain, 43 gm.
2334	1860	.....da	Steer I............	585.5	7,650 gm. straw, 1,650 gm. meadow hay, 1,100 gm. sirup, 50 gm. salt, 34,483 cc. water.	3	90.0	15.5	47.5	......	+27.0	Ash in food, 826 gm.; in urine, 266 gm.; in feces, 462.5 gm.; gain, 97.5 gm.
2335	1860	.....do	Steer II............	577.5	6,917.5 gm. straw, 1,482.5 gm. meadow hay, 1,000 gm. sirup, 50 gm. salt, 38,700 cc. water.	3	85.5	18.5	49.5	......	+17.0	Ash in food, 753 gm.; in urine, 447.5 gm.; in feces, 422.5 gm.; loss, 117 gm.
2336	1860	.....do	Steer I......	571.5	9,300 gm. straw, 250 gm. oil cake, 2,200 gm. sirup, 50 gm. salt, 35,066.5 cc. water.	3	94.5	18.0	56.5	......	+20.0	Ash in food, 886.5 gm.; in urine, 319 gm.; in feces, 425.5 gm.; gain, 142 gm.
2337	1860	.....do	Steer II............	502.0	8,500 gm. straw, 258 gm. oil cake, 2,000 gm. sirup, 50 gm. salt, 34,616.5 cc. water.	3	88.0	19.5	50.0	......	+18.5	Ash in food, 816.5 gm.; in urine, 297 gm.; in feces, 424.5 gm.; gain, 95 gm.
2538	1860	.....do	Steer I............	585.3	7,500 gm. straw, 550 gm. oil cake, 4,400 gm. sirup, 50 gm. salt, 34,062.5 cc. water.	4	134.5	70.5	56.0	......	+ 8.0	Ash in food, 1,036.5 gm.; in urine, 448.5 gm.; in feces, 455 gm.; gain, 133 gm.
2339	1860	.....do	Steer II............	507.5	7,000 gm. straw, 500 gm. oil cake, 4,000 gm. sirup, 50 gm. salt, 33,862.5 cc. water.	4	123.5	69.0	53.0	......	+ 1.5	Ash in food, 959 gm.; in urine, 453.5 gm.; in feces, 421.5 gm.; gain, 84 gm.
2340	1864	.....do	Steer I............	529.5	1,050 gm. clover hay, 2,450 gm. wheat straw, 55,000 gm. mangel-wurzel, 2,000 gm. linseed cake, 50 gm. salt (no water given).	6	195.0	120.0	90.0	......	—15.0	Ash in food. 1,000 gm.; in urine, 450 gm.; in feces, 860 gm.; loss, 310 gm.

TABLE 27.—*Experiments with cattle. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. In milk.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2341	1864	Henneberg and associates.	Steer I	564.8	1,050 gm. clover hay, 2,450 gm. wheat straw, 55,000 gm. mangel-wurzel, 2,000 gm. linseed cake, 50 gm. salt (no water given).	6	210.0	110.0	80.0	......	+20.0	Ash in food, 1,255 gm.; in urine, 465 gm.; in feces, 665 gm.; gain, 125 gm.
2342	1864	....do	....do	567.0	....do	6	210.0	105.0	85.0	......	+20.0	Ash in food, 1,255 gm.; in urine, 500 gm.; in feces, 700 gm.; gain, 55 gm.
2343	1864	....do	....do	573.0	....do	6	210.0	95.0	70.0	......	+45.0	Ash in food, 1,255 gm.; in urine, 480 gm.; in feces, 675 gm.; gain, 100 gm.
2344	1864	....do	Steer II	590.8	1,650 gm. clover hay, 3,850 gm. wheat straw, 60,500 gm. mangel-wurzel, 2,200 gm. linseed cake, 50 gm. salt (no water given).	6	230.0	105.0	100.0	......	+25.0	Ash in food, 1,180 gm.; in urine, 525 gm.; in feces, 900 gm.; loss, 245 gm.
2345	1864	....do	....do	589.5	....do	6	230.0	130.0	95.0	......	+ 5.0	Ash in food. 1,180 gm.; in urine, 525 gm.; in feces, 955 gm.; loss, 380 gm.
2346	1864	....do	....do	611.5	1,650 gm. clover hay, 3,850 gm. wheat straw, 60,500 gm. mangel-wurzel, 2,200 gm. linseed cake, 50 gm. salt (no water given).	6	250.0	115.0	95.0	......	+40.0	Ash in food, 1,525 gm.; in urine, 475 gm.; in feces, 800 gm.; gain, 250 gm.
2347	1864	....do	....do	624.3	....do	6	250.0	140.0	90.0	......	+20.0	Ash in food, 1,525 gm.; in urine, 570 gm.; in feces, 825 gm.; gain, 130 gm.
2348	1864	Grouven	Steer	....	5,000 gm. chopped clover hay	12	106.7	96.7	34.5	......	—24.5	
2349	1864	....do	....do	....	6,000 gm. chopped clover hay	7	141.4	106.1	44.8	......	— 9.5	
2350	1864	....do	....do	....	6,500 gm. chopped clover hay	8	136.0	100.5	43.7	......	— 8.2	
2351	1864	....do	....do	....	....do	10	150.6	106.8	39.5	......	+ 4.3	
2352	1864	....do	Steer (black)	....	Fasting	8	9.8	48.3	7.4	......	—45.9	The consumed nitrogen was calculated from the contents of the stomach. The nitrogen in the urine includes 0.3 gm. from hair.

2353	1864	....do	Steer (brown)	....	....do	5	19.1	48.8	9.6	......	—39.3	Do.
2354	1864	....do	Steer (black)	....	....do	4	19.6	43.2	14.9	......	—38.5	First four days of No. 2352.
2355	1864	....do	Steer	....	....do	4	0.0	54.0	0.0	......	—54.0	Last four days of No. 2352.
2356	1864	....do	Steer I	....	....do	4	17.0	37.5	8.6	......	—29.1	The consumed nitrogen was calculated from the contents of the stomach. The nitrogen in the urine includes 0.9 gm. from hair.
2357	1864	....do	....do	....	....do	3	11.2	40.6	(8.6)	......	—38.0	The consumed nitrogen was calculated from the contents of the stomach. The nitrogen in the urine includes 0.3 gm. from hair.
2358	1864	....do	....do	....	4,398 gm. straw, 11,002 gm. water, 50 gm. salt.	20	29.4	15.2	19.4	......	— 5.2	In Nos. 2358–2367 the nitrogen in urine includes 0.9 gm. from hair. Ash in food, 250.7 gm.; in urine, 82.6 gm.; in feces, 166.9 gm.; gain, 1.2 gm.
2359	1864	....do	Steer II	....	3,139.8 gm. straw, 6,989.5 gm. water, 50 gm. salt.	20	21.0	14.0	16.5	......	— 9.5	Ash in food, 192.0 gm.; in urine, 68.9 gm.; in feces, 124.5 gm.; loss, 1.4 gm.
2360	1864	....do	Steer I	....	4,517.5 gm. straw, 13,240 gm. water, 50 gm. salt.	6	30.3	17.6	22.6	......	— 9.9	First 6 days of No. 2358. Ash in food, 257.5 gm.; in urine, 60.3 gm.; in feces, 172.3 gm.; gain, 24.9 gm.
2361	1864	....do	....do	....	4,393 gm. straw, 11,473 gm. water, 50 gm. salt.	5	29.4	15.7	17.7	......	— 4.0	Seventh to eleventh day of No. 2358. Ash in food, 250.7 gm.; in urine, 93.0 gm.; in feces, 169.9 gm.; loss, 12.2 gm.
2362	1864	....do	....do	....	4,503 gm. straw, 11,094 gm. water, 50 gm. salt.	5	30.1	14.0	18.4	......	— 1.3	Twelfth to sixteenth day of No. 2358. Ash in food, 255.4 gm.; in urine, 92.1 gm.; in feces, 163.1 gm.; gain, 0.2 gm.
2363	1864	....do	....do	....	4,097.5 gm. straw, 6,942.5 gm. water, 50 gm. salt.	4	27.4	16.6	18.2	......	— 7.4	Seventeenth to twentieth day of No. 2358. Ash in food, 234.6 gm.; in urine, 91.3 gm.; in feces, 158.9 gm.; loss, 15.6 gm.

TABLE 27.—*Experiments with cattle. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. In milk.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2364	1864	Grouven	Steer II	......	3,049.2 gm. straw, 6,259.2 gm. water, 50 gm. salt.	6	20.4	15.9	17.8	......	—13.3	First 6 days of No. 2359. Ash in food, 187.4 gm.; in urine, 78.4 gm.; in feces, 132.5 gm.; loss, 23.5 gm.
2365	1864	....do	....do	......	3,266 gm. straw, 7,578 gm. water, 50 gm. salt.	5	21.8	14.4	16.1	......	— 8.7	Seventh to eleventh day of 2359. Ash in food, 198.0 gm.; in urine, 63.9 gm.; in feces, 138.9 gm.; loss, 4.8 gm.
2366	1864	....do	....do	......	2,859 gm. straw, 6,673 gm. water, 50 gm. salt.	5	19.1	14.2	13.6	......	— 8.7	Twelfth to sixteenth day of No. 2359. Ash in food, 179.2 gm.; urine, 60.6 gm.; in feces, 109.1 gm.; gain, 9.5 gm.
2367	1864	....do	....do	......	3,468.8 gm. straw, 7,745 gm. water, 50 gm. salt.	4	23.3	14.6	18.5	......	— 9.8	Seventeenth to twentieth day of No. 2359. Ash in food, 207.1 gm.; in urine, 71.4 gm.; in feces, 114.1 gm.; gain, 21.6 gm.
2368	1864	....do	Steer I	......	2,497.5 gm. straw, 8,971.2 gm. water, 50 gm. salt.	4	12.4	18.0	14.8	......	—20.4	Period I. In Nos. 2368–2372 the nitrogen in urine includes 0.3 gm. from hair. Ash in food, 166.0 gm.; in urine, 76.9 gm.; in feces, 123.0 gm.; loss, 33.9 gm.
2369	1864	....do	....do	......	3,746.2 gm. straw, 9,995 gm. water, 50 gm. salt.	4	18.6	14.0	18.5	......	—13.9	Period II. Ash in food, 223.0 gm.; in urine, 100.1 gm.; in feces, 179.4 gm.; loss, 56.5 gm.
2370	1864	....do	Steer III	......	2,997.5 gm. straw, 4,690 gm. water, 50 gm. salt.	4	14.9	22.8	18.4	......	—26.3	Period I. Ash in food, 92.5 gm.; in urine, 93.0 gm.; in feces, 140.5 gm.; loss, 141.0 gm.

2371	1864	....do	....do	....	4,493 gm. straw, 11,582.5 gm. water, 50 gm. salt.	4	22.4	25.4	19.8	......	—22.8	Period II. Ash in food, 257.5 gm.; in urine, 68.7 gm.; in feces, 204.8 gm.; gain, 16.0 gm.
2372	1864	....do	Steer II	....	2,676.7 gm. straw, 8,389.4 gm. water, 50 gm. salt.	9	19.0	10.9	11.4	......	— 3.3	Ash in food, 179.4 gm.; in urine, 66.7 gm.; in feces, 89.8 gm.; gain, 22.9 gm.
2373	1864	....do	Steer I	....	3,742.7 gm. straw, 10,276.8 gm. water, 63.6 gm. salt.	11	18.6	21.6	18.6	......	—21.6	In Nos. 2373, 2374 the nitrogen in urine includes 0.9 gm. from hair. Ash in food, 235.5 gm.; in urine, 114.4 gm.; in feces, 188.2 gm.; loss, 67.1 gm.
2374	1864	....do	Steer III	....	4,492.7 gm. straw, 11,167.7 gm. water, 63.6 gm. salt.	11	22.4	30.9	22.4	......	—30.9	Ash in food, 269.8 gm.; in urine, 120.4 gm.; in feces, 236.8 gm.; loss, 87.4 gm.
2375	1864	....do	Steer I	....	2,992.3 gm. straw, 1,000 gm. cane sugar, 10,189 gm. water, 50 gm. salt.	11	20.7	9.6	17.5	......	— 6.4	Period I. In Nos. 2375–2401 the nitrogen in urine includes 0.3 gm. from hair. Ash in food, 217.3 gm.; in urine, 81.8 gm.; in feces, 160.4 gm.; loss, 24.9 gm.
2376	1864	....do	....do	....	2,960 gm. straw, 1,500 gm. cane sugar, 11,522 gm. water, 50 gm. salt.	6	20.5	8.7	15.9	......	— 4.1	Period II. Ash in food, 218.8 gm.; in urine, 97.8 gm.; in feces, 180.4 gm.; loss, 59.4 gm.
2377	1864	....do	Steer II	....	2,422 gm. straw, 100 gm. cane sugar, 84,520 gm. water, 50 gm. salt.	11	16.8	9.6	14.1	......	— 6.9	Period I. Ash in food, 189.8 gm.; in urine, 94.1 gm.; in feces, 122.8 gm.; loss, 27.1 gm.
2378	1864	....do	....do	....	2,376 gm. straw, 1,500 gm. cane sugar, 82,450 gm. water, 50 gm. salt.	6	16.4	15.1	13.5	......	—12.2	Period II. Ash in food, 189.6 gm.; in urine, 86.6 gm.; in feces, 128.9 gm.; loss, 25.9 gm.
2379	1864	....do	Steer I	....	3,982 gm. straw, 500 gm. grape sugar, 14,750 gm. water, 50 gm. salt.	5	28.9	20.0	20.2	......	—11.3	Period I. Ash in food, 246.4 gm.; in urine, 92.4 gm.; in feces, 205.5 gm.; loss, 51.5 gm.
2380	1864	....do	....do	....	3,189 gm. straw, 1,000 gm. grape sugar, 14,550 gm. water, 50 gm. salt.	5	24.3	12.8	18.0	......	— 6.5	Period II. Ash in food, 212.6 gm.; in urine, 79.7 gm.; in feces, 159.7 gm.; loss, 26.8 gm.
2381	1864	....do	....do	....	2,498 gm. straw, 1.500 gm. grapé sugar, 11,840 gm. water, 50 gm. salt.	5	20.5	13.0	20.0	......	—12.5	Period III. Ash in food, 191.9 gm.; in urine, 80.3 gm.; in feces, 149.9 gm.; loss, 38.3 gm.

TABLE 27.—*Experiments with cattle. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.					Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	In milk.	Gain (+) or loss(—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2382	1864	Grouven	Steer II	......	2,025 gm. straw, 500 gm. grape sugar, 5,758 gm. water, 50 gm. salt.	5	15.2	17.5	11.0	......	—13.3	Period I. Ash in food, 149.0 gm.; in urine, 53.8 gm.; in feces, 133.8 gm.; loss, 38.6 gm.
2383	1864	...do	...do	......	2,198 gm. straw, 1,000 gm. grape sugar, 8,743 gm. water, 50 gm. salt.	5	17.4	10.4	13.0	......	— 6.0	Period II. Ash in food, 162.5 gm.; in urine, 82.3 gm.; in feces, 132.1 gm.; loss, 51.9 gm.
2384	1864	...do	...do	......	1,603 gm. straw, 1,500 gm. grape sugar, 6,185 gm. water, 50 gm. salt.	5	14.3	8.6	13.9	......	— 8.2	Period III. Ash in food, 136.4 gm.; in urine, 62.3 gm.: in feces, 90.4 gm.; loss, 16.3 gm.
2385	1864	...do	Steer I	......	4,073 gm. straw, 1,250 gm. starch, 16,432 gm. water, 50 gm. salt.	8	29.8	14.2	30.0	......	—14.4	Period I. Ash in food, 258.5 gm.; in urine, 85.6 gm.; in feces, 196.7 gm.; loss, 23.8 gm.
2386	1864	...do	...do	......	2,789 gm. straw, 2,250 gm. starch, 14,600 gm. water, 50 gm. salt.	8	21.5	11.0	22.3	......	—11.8	Period II. Ash in food, 203.1 gm.; in urine, 57.3 gm.. in feces, 179.1 gm.; loss, 33.3 gm.
2387	1864	...do	...do	......	2,494 gm. straw, 1,000 gm. dextrin, 7,428 gm. water, 50 gm. salt.	5	14.4	12.2	14.2	......	—12.0	Period I. Ash in food, 170.8 gm.; in urine, 60.5 gm.; in feces, 111.8 gm.: loss, 1.5 gm.
2388	1864	...do	...do	......	2,498 gm. straw, 1,500 gm. dextrin, 8,670 gm. water, 50 gm. salt.	4	15.4	11.6	16.8	......	—13.0	Period II. Ash in food, 174.5 gm.; in urine, 53.9 gm.; in feces, 98.9 gm.; gain, 21.7 gm.
2389	1864	...do	...do	......	2,191 gm. straw, 2,318 gm. dextrin, 10,550 gm. water, 50 gm. salt.	4	15.5	12.6	13.5	......	—10.6	Period III. Ash in food, 166.5 gm.; in urine, 50.8 gm.; in feces, 105.8 gm.; gain. 9.9 gm.
2390	1864	...do	Steer III	......	2,993 gm. straw, 1,000 gm. dextrin, 6,162 gm. water, 50 gm. salt.	5	16.9	19.7	16.9	......	—19.7	Period I. Ash in food, 192.2 gm.; in urine, 75.5 gm.; in feces, 169.0 gm.: loss, 52.3 gm.
2391	1864	...do	...do	......	3,000 gm. straw, 1,500 gm. dextrin, 8,239 gm. water, 50 gm. salt.	4	17.9	15.2	19.4	......	—16.7	Period II. Ash in food, 196.9 gm.; in urine, 71.4 gm.; in feces, 168.0 gm.; loss, 42.5 gm.

2392	1864	....do	....do	....	2,984 gm. straw, 2,500 gm. dextrin, 9,538 gm. water, 50 gm. salt.	5	19.8	16.5	20.0	......	—16.7	Period III. Ash in food, 202.8 gm.; in urine, 79.7 gm.; in feces, 124.7 gm.; loss, 1.6 gm.
2393	1864	....do	Steer I	....	2,498 gm. straw, 1,000 gm. gum, 13,118 gm. water, 50 gm. salt.	4	16.6	15.5	16.5	......	—15.4	Period I. Ash in food, 222.0 gm.; in urine, 123.9 gm.; in feces, 106.5 gm.; loss, 8.4 gm.
2394	1864	....do	....do	....	2,494 gm. straw, 1,500 gm. gum, 8,702 gm. water, 50 gm. salt.	3	18.7	11.1	20.7	......	—13.1	Period II. Ash in food, 245.2 gm.; in urine, 98.3 gm.; in feces, 143.5 gm.; gain, 3.4 gm.
2395	1864	....do	Steer III	....	2,999 gm. straw, 1,000 gm. gum, 10,064 gm. water, 50 gm. salt.	4	19.1	25.0	15.4	......	—21.3	Period I. Ash in food, 242.3 gm.; in urine, 104.1 gm.; in feces, 162.1 gm.; loss, 23.9 gm.
2396	1864	....do	....do	....	2,995 gm. straw, 1,500 gm. gum, 10,200 gm. water, 50 gm. salt.	3	21.2	15.1	20.3	......	—15.2	Ash in food, 268.3 gm.; in urine, 107.8 gm.; in feces, 177.7 gm.; loss, 17.2 gm.
2397	1864	....do	Steer I	....	2,500 gm. straw, 375 gm. wax, 7,076 gm. water, 50 gm. salt.	9	16.8	18.1	11.7	......	—13.0	Ash in food, 185.6 gm.; in urine, 84.6 gm.; in feces, 120.7 gm.; loss, 19.7 gm.
2398	1864	....do	....do	....	2,494 gm. straw, 6,138 gm. water, 1,078 gm. alcohol + 170 gm. water, 50 gm. salt.	5	12.5	21.5	10.9	......	—19.9	Ash in food, 164.3 gm.; in urine, 79.0 gm.; in feces, 118.7 gm.; loss, 33.4 gm.
2399	1864	....do	....do	....	2,500 gm. straw, 1,500 gm. straw fiber, 11,060 gm. water, 50 gm. salt.	3	14.3	14.4	16.2	......	—16.3	Ash in food, 218.0 gm.; in urine, 70.8 gm.; in feces, 176.0 gm.; loss, 28.8 gm.
2400	1864	....do	Steer III	....	3,000 gm. straw, 1,150 gm. paper fiber, 7,886 gm. water, 50 gm. salt.	5	17.3	14.4	16.6	......	—13.7	Ash in food, 224.7 gm.; in urine, 92.0 gm.; in feces, 175.3 gm.; loss, 42.6 gm.
2401	1864	....do	Steer I	....	2,658 gm. straw, 993 gm. pectin, 8,664 gm. water, 50 gm. salt.	8	16.6	16.8	15.1	......	—15.3	Ash in food, 259.3 gm.; in urine, 113.7 gm.; in feces, 159.6 gm.; loss, 14.0 gm.
2402	1870	Henneberg and associates.	Steer I	570.5	7,100 gm. oat straw, 1,300 gm. clover hay, 250 gm. rape-seed cake, 50 gm. salt.	......	73.0	22.5	39.5	......	+11.0	In Nos. 2402, 2403 the figures are calculated for an animal weighing 1,000 pounds, based on Nos. 2334, 2336, and 2338. Ash in food, 520 gm.; in urine, 160 gm.; in feces, 305 gm.; gain, 55 gm.
2403	1870	....do	....do	568.0	4,600 gm. clover hay, 5,550 gm. oat straw, 9,250 gm. beet root, 500 gm. rape-seed cake, 20 gm. bean meal, 50 gm. salt.	......	153.0	79.0	73.5	......	+ 0.5	Ash in food, 730 gm.; in urine, 280 gm.; in feces, 455 gm; loss, 5 gm.

TABLE 27.—*Experiments with cattle. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. In milk.	Nitrogen. Gain (+) or loss (−).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2404	1870	Henneberg and associates.	Steer I	575.0	6,350 gm. oat straw, 23,900 gm. mangel-wurzels, 50 gm. salt.	......	69.5	24.5	41.0	......	+ 4.0	Ash in food, 625 gm.; in urine, 325 gm.; in feces, 350 gm.; loss, 50 gm.
2405	1870	....do	....do	570.5	6,300 gm. oat straw, 12,800 gm. mangel-wurzels, 500 gm. rape-seed cake, 50 gm. salt.	......	73.0	20.5	31.5	......	+21.0	Ash in food, 540 gm.; in urine, 265 gm.; in feces, 345 gm.; loss, 70 gm.
2406	1870	....do	....do	667.5	2,500 gm. meadow hay, 4,000 gm. wheat straw, 20,000 gm. mangel-wurzels, 2,000 gm. beet-sugar molasses, 1,500 gm. rape-seed cake, 1,000 gm. bean meal, 50 gm. salt.	24	250.0	150.0	85.0	......	+15.0	Ash in food, 1,055 gm.; in urine, —— gm.; in feces, 655 gm.
2407	1870	....do	Steer II	501.5	9,750 gm. clover hay, 50 gm. salt	......	156.0	82.5	88.5	......	— 15.0	In Nos. 2407–2409 the figures are based on Nos. 2335, 2337, and 2339. Ash in food, 570 gm.; in urine, 200 gm.; in feces, 570 gm.; loss, 200 gm.
2408	1870	....do	....do	535.0	5,500 gm. oat straw, 1,850 gm. clover hay, 300 gm. rape-seed cake, 50 gm. salt.	......	79.0	25.0	34.5	......	+19.5	Ash in food, 515 gm.; in urine, 205 gm.; in feces, 350 gm.; loss, 40 gm.
2409	1870	....do	....do	526.0	6,650 gm. rye straw, 1,900 gm. clover hay, 300 gm. rape-seed cake, 50 gm. salt.	......	79.0	44.5	39.5	......	— 5.0	Ash in food, 430 gm.; in urine, 155 gm.; in feces, 325 gm.; loss, 50 gm.
2410	1870	....do	....do	586.0	2,200 gm. meadow hay, 3,500 gm. wheat straw, 17,750 gm. mangel-wurzels, 1,750 gm. beet molasses, 1,300 gm. rape-seed cake, 900 gm. bean meal, 50 gm. salt.	24	220.0	150.0	80.0	......	—10.0	Ash in food, 935 gm.; in urine, —— gm.; in feces, 475 gm.
2411	1870	....do	Steer I	558.5	1,050 gm. clover hay, 2,450 gm. wheat straw, 55,000 gm. mangel-wurzels, 2,000 gm. linseed cake, 50 gm. salt.	......	210.0	105.0	80.0	......	+25.0	Average of Nos. 2340–2343. Ash in food, 1,190 gm.; in urine, 475 gm.; in feces, 725 gm.; loss, 10 gm.
2412	1870	....do	Steer II	604.0	1,650 gm. clover hay, 3,850 gm. wheat straw, 60,500 gm. mangel-wurzels, 2,200 gm. linseed cake, 50 gm. salt.	......	245.0	120.0	95.0	......	+30.0	Average of Nos. 2344–2347. Ash in food, 1,350 gm.; in urine, 525 gm.; in feces, 870 gm.; loss, 45 gm.
2413	1870	....do	Steer I	530.5	9,435 gm. oat straw, 1,000 gm. bean meal, 50 gm. salt.	6	130.0	40.0	45.0	......	+45.0	Ash in food, 730 gm.; in urine, 215 gm.; in feces, 510 gm.; gain, 5 gm.

2414	1870	....do	....do	522.0	8,925 gm. bean straw, 800 gm. bean meal, 50 gm. salt.	6	165.0	80.0	60.0	......	+25.0	Ash in food, 505 gm.; in urine, 240 gm.; in feces, 250 gm.; gain, 15 gm.
2415	1870	....do	....do	514.0	7,440 gm. bean straw, 50 gm. salt	6	110.0	50.0	60.0	......	0.0	Ash in food, 420 gm.; in urine, 265 gm.; in feces, 205 gm.; loss, 50 gm.
2416	1870	....do	....do	494.0	8,450 gm. meadow hay, 50 gm. salt	6	170.0	70.0	65.0	......	+35.0	Ash in food, 590 gm.; in urine, 240 gm.; in feces, 305 gm.; gain, 45 gm.
2417	1870	....do	....do	499.0	8,425 gm. meadow hay, 900 gm. bean meal, 50 gm. salt.	6	205.0	105.0	65.0	......	+35.0	Ash in food, 620 gm.; in urine, 255 gm.; in feces, 380 gm.; loss, 15 gm.
2418	1870	....do	....do	513.0	10,200 gm. clover hay, 50 gm. salt	19	215.0	100.0	105.0	......	+10.0	Ash in food, 625 gm.; in urine, 250 gm.; in feces, 375 gm.; gain or loss, 0.
2419	1870	....do	....do	538.5	12,500 gm. clover hay, 50 gm. salt	14	275.0	120.0	135.0	......	+20.0	Ash in food, 790 gm.; in urine, 310 gm.; in feces, 475 gm.; gain, 5 gm.
2420	1870	....do	....do	531.5	4,500 gm. clover hay, 4,500 gm. wheat straw, 250 gm. bean meal, 1,150 gm. starch, 400 gm. sugar, 50 gm. salt.	6	150.0	55.0	85.0	......	+10.0	Ash in food, 690 gm.; in urine, 195 gm.; in feces, 500 gm.; loss, 5 gm.
2421	1870	....do	....do	533.5	4,500 gm. clover hay, 4,500 gm. wheat straw, 100 gm. bean meal, 2,550 gm. starch, 400 gm. sugar, 50 gm. salt.	7	150.0	35.0	90.0	......	+25.0	Ash in food, 760 gm.; in urine, 190 gm.; in feces, 595 gm.; loss, 25 gm.
2422	1870	....do	Steer II	639.5	10,850 gm. oat straw, 1,150 gm. bean meal, 50 gm. salt.	6	150.0	40.0	55.0	......	+55.0	Ash in food, 835 gm.; in urine, 245 gm.; in feces, 575 gm.; gain, 15 gm.
2423	1870	....do	....do	638.5	11,240 gm. bean straw, 1,000 gm. bean meal, 50 gm. salt.	6	205.0	95.0	85.0	......	+25.0	Ash in food, 625 gm.; in urine, 330 gm.; in feces, 340 gm.; loss, 45 gm.
2424	1870	....do	....do	625.0	8,450 gm. wheat straw, 650 gm. bean meal, 50 gm. salt.	6	100.0	35.0	55.0	......	+10.0	Ash in food, 555 gm.; in urine, 105 gm.; in feces, 495 gm.; loss, 45 gm.
2425	1870	....do	....do	595.0	10,340 gm. meadow hay, 1,100 gm. bean meal, 50 gm. salt.	6	250.0	130.0	95.0	......	+25.0	Ash in food, 745 gm.; in urine, 310 gm.; in feces, 520 gm.; loss, 85 gm.
2426	1870	....do	....do	617.0	12,050 gm. clover hay, 50 gm. salt	18	255.0	120.0	120.0	......	+15.0	Ash in food, 730 gm.; in urine, 280 gm.; in feces, 465 gm.; loss, 15 gm.
2427	1870	....do	....do	649.0	14,500 gm. clover hay, 50 gm. salt	14	320.0	140.0	155.0	......	+25.0	Ash in food, 910 gm.; in urine, 330 gm.; in feces, 570 gm.; gain, 10 gm.
2428	1870	....do	....do	643.0	5,200 gm. clover hay, 5,200 gm. wheat straw, 300 gm. bean meal, 1,300 gm. starch, 450 gm. sugar, 50 gm. salt.	6	175.0	55.0	105.0	......	+15.0	Ash in food, 785 gm.; in urine, 145 gm.; in feces, 655 gm.; loss, 15 gm.
2429	1870	....do	....do	644.5	5,200 gm. clover hay. 5,200 gm. wheat straw, 1,350 gm. bean meal, 700 gm. starch, 400 gm. sugar, 50 gm. salt.	7	215.0	80.0	95.0	......	+40.0	Ash in food, 785 gm.; in urine, 210 gm.; in feces, 590 gm.; loss, 15 gm.
2430	1870	....do	....do	639.5	5,200 gm. clover hay, 5,200 gm. wheat straw, 2,500 gm. bean meal, 400 gm. sugar, 50 gm. salt.	7	265.0	115.0	100.0	......	+50.0	Ash in food, 785 gm.; in urine, 245 gm.; in feces, 560 gm.; loss, 20 gm.

TABLE 27.—*Experiments with cattle. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. In milk.	Nitrogen. Gain (+) or loss (−).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2431	1870	Henneberg and associates.	Steer II	650.5	5,000 gm. clover hay, 5,000 gm. wheat straw, 250 gm. bean meal, 3,600 gm. starch, 200 gm. rape-seed oil, 2,000 gm. sugar, 75 gm. salt.	5	205.0	60.0	115.0	......	+30.0	Ash in food, 900 gm.; in urine, 260 gm.; in feces, 750 gm.; loss, 110 gm.
2432	1870	...do	...do	651.0	5,000 gm. clover hay, 5,000 gm. wheat straw, 1,700 gm. bean meal, 2,200 gm. starch, 2,000 gm. sugar, 200 gm. rape-seed oil, 75 gm. salt.	5	260.0	100.0	120.0	......	+40.0	Ash in food, 875 gm.; in urine, 270 gm.; in feces, 740 gm.; loss, 135 gm.
2433	1870	...do	...do	656.5	5,000 gm. clover hay, 5,000 gm. wheat straw, 3,200 gm. bean meal, 850 gm. starch, 2,000 gm. sugar, 200 gm. rape-seed oil, 75 gm. salt.	7	315.0	170.0	115.0	......	+30.0	Ash in food, 840 gm.; in urine, 310 gm.; in feces, 630 gm.; loss, 100 gm.
2434	1870	...do	...do	659.0	5,000 gm. clover hay, 5,000 gm. wheat straw, 4,700 gm. bean meal, 1,550 gm. sugar, 200 gm. rape-seed oil, 75 gm. salt.	5	390.0	220.0	120.0	......	+50.0	Ash in food, 965 gm.; in urine, 330 gm.; in feces, 640 gm.; loss, 5 gm.
2435	1870	...do	...do	671.0	5,000 gm. clover hay, 5,000 gm. wheat straw, 5,850 gm. bean meal, 1,400 gm. starch, 300 gm. rape-seed oil, 75 gm. salt.	13	425.0	205.0	125.0	......	+95.0	Ash in food, 1,000 gm.; in urine, 290 gm.; in feces, 740 gm.; loss, 30 gm.
2436	1870	...do	...do	682.5	5,000 gm. clover hay, 5,000 gm. wheat straw, 5,850 gm. bean meal, 2,350 gm. starch, 75 gm. salt.	9	430.0	225.0	145.0	......	+60.0	Ash in food, 1,040 gm.; in urine, 285 gm.; in feces, 800 gm.; loss, 45 gm.
2437	1870	...do	Steer I *a*	529.5	5,000 gm. clover hay, 5,000 gm. wheat straw, 4,350 gm. bean meal, 1,350 gm. starch, 400 gm. sugar, 50 gm. salt.	6	340.0	115.0	125.0	......	+100.0	Ash in food, 900 gm.; in urine, 230 gm.; in feces, 720 gm.; loss, 50 gm.
2438	1870	...do	...do	536.0	5,000 gm. clover hay, 5,000 gm. wheat straw, 4,350 gm. bean meal, 1,150 gm. starch, 200 gm. rape-seed oil, 75 gm. salt.	5	350.0	145.0	110.0	......	+95.0	Ash in food, 830 gm.; in urine, 260 gm.; in feces, 620 gm.; loss, 50 gm.
2439	1870	...do	...do	539.5	5,000 gm. clover hay, 5,000 gm. wheat straw, 2,800 gm. bean meal, 2,600 gm. starch, 200 gm. rape-seed oil, 75 gm. salt.	5	290.0	90.0	115.0	......	+85.0	Ash in food, 830 gm.; in urine, 220 gm.; in feces, 695 gm.; loss, 85 gm.
2440	1870	...do	...do	555.5	5,000 gm. clover hay, 5,000 gm. wheat straw, 2,150 gm. bean meal, 3,200 gm. starch, 200 gm. rape-seed oil, 75 gm. salt.	5	280.0	90.0	120.0	......	+70.0	Ash in food, 965 gm.; in urine, 230 gm.; in feces, 755 gm.; loss, 20 gm.
2441	1870	...do	...do	564.0	5,000 gm. clover hay, 5,000 gm. wheat straw, 4,350 gm. bean meal, 1,800 gm. starch, 75 gm. salt.	13	365.0	145.0	125.0	......	+95.0	Ash in food, 975 gm.; in urine, 250 gm.; in feces, 685 gm.; gain, 40 gm.

2442	1870	.....do	.....do	580.5	5,000 gm. clover hay, 5,000 gm. wheat straw, 4,350 gm. bean meal, 850 gm. starch, 300 gm. rape-seed oil, 75 gm. salt.	9	360.0	185.0	120.0	......	+55.0	Ash in food, 935 gm.; in urine, 215 gm.; in feces, 710 gm.; gain, 10 gm.
2443	1893	Emery and Kilgore.	Steer I	....	8,086 gm. cotton-seed hulls, 4,062 gm. cotton-seed meal.	8	351.5	180.1	122.5	......	+48.9	P_2O_5 in food, 143.4 gm.; in urine, 22.4 gm.; in feces, 99.0 gm.; gain, 22.0 gm. K_2O in food, 150.5 gm.; in urine, 94.4 gm.; in feces, 48.8 gm.; gain, 7.3 gm.
2444	1893	.....do	Steer II	....	7,371 gm. cotton-seed hulls, 4,078 gm. cotton-seed meal.	8	336.3	195.0	124.7	......	+16.6	P_2O_5 in food, 137.4 gm.; in urine, 35.4 gm.; in feces, 88.2 gm.; gain, 13.8 gm. K_2O in food, 142.6 gm.; in urine, 91.9 gm.; in feces, 49.3 gm.; gain, 1.4 gm.
2445	1893	.....do	Steer III	....	6,464 gm. cotton-seed hulls, 4,185 gm. cotton-seed meal.	8	346.8	190.7	122.6	......	+33.5	P_2O_5 in food, 141.5 gm.; in urine, 50.7 gm.; in feces, 72.6 gm.; gain, 18.2 gm. K_2O in food, 137.2 gm.; in urine, 107.4 gm.; in feces, 35.0 gm.; loss, 5.4 gm.
2446	1893	.....do	Steer IV	....	6,124 gm. cotton-seed hulls, 4,069 gm. cotton-seed meal.	8	335.0	181.7	115.4	......	+37.9	P_2O_5 in food, 136.6 gm.; in urine, 11.6 gm.; in feces, 111.4 gm.; gain, 13.6 gm. K_2O in food, 131.8 gm.; in urine, 76.5 gm.; in feces, 52.7 gm.; gain, 2.6 gm.

No. 2307. Ann. Chim. et Phys., 71, p. 127. No. 2308. Ztschr. Biol., 5, 122 (Jour. Landw. 1871, 171, Neue Beiträge, Fütterung der Wiederkäuer, 2, p. 383). No. 2309. Landw. Vers. Stat., 12, p. 450. Jour. Landw. 1871, p. 171. Nos. 2310, 2311. Ibid., p. 419. Nos. 2312, 2313. Jour. Landw. 1871, 171 (Virchow's Arch., 51, p. 36). Nos. 2314–2320. Jour. Landw. 1871, 171 (Landw. Vers. Stat., 12, 450, Neue Beiträge zur Fütterung der Wiederkäner, 2, p. 383). No. 2321. New York State Sta. Rpt. 1883, pp. 98, 112. Nos. 2322, 2323. North Carolina Sta. Bul. 80c, pp. 11, 12. Nos. 2324, 2325. Minnesota Sta. Bul. 26, p. 14. No. 2326. Fütterung der Wiederkäuer (ed. 1860), p. 30. No. 2327. Ibid., p. 31. Nos. 2328, 2329. Ibid., pp. 39, 40. Nos. 2330, 2331. Ibid., pp. 49, 50. Nos. 2332, 2333. Ibid., pp. 59, 60. No. 2334. Ibid., pp. 199, 200. No. 2335. Ibid., pp. 199, 201. No. 2336. Ibid., pp. 208, 209. No. 2337. Ibid., pp. 208, 210. No. 2338. Ibid., pp. 219, 220. No. 2339. Ibid., pp. 219, 221. Nos. 2340–2342. Fütterung der Wiederkäuer (ed. 1864), p. 308. Nos. 2343–2347. Ibid., p. 309. No. 2348. Zweiter Bericht aus der agrikulturchemischen Versuchstation zu Salzmünde, p. 122. Nos. 2349–2351. Ibid., p. 123. Nos. 2352, 2353. Ibid., pp. 158, 159. No. 2354. Ibid., p. 163. No. 2355. Ibid., p. 165. Nos. 2356, 2357. Ibid., p. 173. No. 2358. Ibid., p. 279. No. 2359. Ibid., p. 281. No. 2360. Ibid., p. 283. No. 2361. Ibid., p. 285. No. 2362. Ibid., p. 287. No. 2363. Ibid., p. 289. No. 2364. Ibid., p. 291. No. 2365. Ibid., p. 293. No. 2366. Ibid., p. 295. No. 2367. Ibid., p. 297. No. 2368. Ibid., p. 307. No. 2369. Ibid., p. 309. No. 2370. Ibid., p. 311. No. 2371. Ibid., p. 313. No. 2372. Ibid., p. 319. No. 2373. Ibid., p. 327. No. 2374. Ibid., p. 330. No. 2375. Ibid., p. 356. No. 2376. Ibid., p. 358. No. 2377. Ibid., p. 360. No. 2378. Ibid., p. 362. No. 2379. Ibid., p. 371. No. 2380. Ibid., p. 373. No. 2381. Ibid., p. 375. No. 2382. Ibid., p. 377. No. 2383. Ibid., p. 379. No. 2384. Ibid., p. 381. No. 2385. Ibid., p. 390. No. 2386. Ibid., p. 393. No. 2387. Ibid., p. 403. No. 2388. Ibid., p. 405. No. 2389. Ibid., p. 408. No. 2390. Ibid., p. 410. No. 2391. Ibid., p. 413. No. 2392. Ibid., p. 415. No. 2393. Ibid., p. 424. No. 2394. Ibid., p. 426. No. 2395. Ibid., p. 429. No. 2396. Ibid., p. 431. No. 2397. Ibid., p. 443. No. 2398. Ibid., p. 452. No. 2399. Ibid., p. 463. No. 2400. Ibid., p. 465. No. 2401. Ibid., p. 479. Nos. 2402–2442. Neue Beiträge zur Fütterung der Wiederkäuer (ed. 1870), Table 2, p. 462. Nos. 2443, 2444. North Carolina Sta. Bul. 118, p. 250. Nos. 2445, 2446. Ibid., p. 251.

No. 2307 was made by Boussingault in 1838. The object was to compare the food and excretory products of a milch cow to see whether Herbivora derived nitrogen from the air or not. The food consisted of potatoes and rowen. Elementary analyses of food, urine, feces, and milk were made. Somewhat more nitrogen was excreted than was consumed.

The conclusion was reached that it was extremely improbable that any nitrogen was absorbed from the air during respiration.

The excretion of carbon and hydrogen was briefly discussed.

No. 2308 was made by Voit and his assistants in Munich in 1867, to study the formation of fat from protein and the metabolism of nitrogen. The subject was a cow. She had been previously fed meadow hay and meal, and the same feeding stuffs were used during the test. Sufficient quantities of these two materials for each of the 6 days were weighed out, the hay tied up in bundles, and samples taken for analysis. The urine and feces were collected directly. The urine was thoroughly mixed and samples taken for analysis each day. The urine was evaporated with quartz sand, and the nitrogen in it and in the feces and milk determined by the soda-lime method. The fat in milk, food, and feces was also determined. The nitrogen consumed during the whole period was 1,448.8 grams, the amount excreted, 1431.1 grams. The difference was 17.7 grams, or 1.2 per cent of the whole. This difference is, in the author's opinion, within the limit of error, since in dealing with such large quantities it is difficult to take samples for analysis which will accurately represent the average composition.

No. 2309. See No. 2314.

Nos. 2310 and 2311 were made by Kühn and Fleischer at the Experiment Station at Möckern in 1867. The object was to study the formation of fat in the animal organism. The subjects were 2 cows. Their food consisted of hay and starch. The food, urine, feces, and milk were analyzed. No conclusion was reached concerning the metabolism of nitrogen except that the subjects were in nitrogen equilibrium.

Nos. 2312 and 2313 were made by Fleischer at Hohenheim in 1870, and are quoted by Henneberg, with no details.

Nos. 2314–2320 and 2309 were made by Kühn and Fleischer at the Experiment Station at Möckern in 1867–68. The object was to determine the influence of changing the food upon milk production and upon the digestibility of coarse fodder, and also the changes produced by adding easily digested feeding stuffs to the ration. The subjects were 2 cows, weighing about 399 and 383 kilograms, respectively. The basal ration consisted of meadow hay. To this rape-seed meal with the oil extracted, rape-seed oil, starch, or bean meal was added in several instances. The food, urine, feces, and milk were analyzed.

The conclusion was reached that, generally speaking, all the nitrogen consumed was excreted in the milk, urine, and feces. If this was not the case, it was because nitrogen equilibrium was not reached before the experiment began. The nitrogen balance is discussed very briefly. The other points investigated are discussed at length but are not quoted here.

This is the first of an extended series of investigations by Kühn and his associates in which the principal object was to get light upon the effect of food upon milk production by cows. This was followed by experiments with steers, which culminated in a series of respiration experiments which are described beyond (Nos. 3468–3499, Table 38).

These experiments, taken together, make one of the most important series which have been made with domestic animals.

No. 2321. This experiment, which was made at the New York State Station in 1883, was reported by Sturtevant. It forms part of an extended feeding experiment with 4 cows. The results were calculated for 1 cow. The composition of the food was determined, and it is probable that the nitrogen in the urine, feces, and milk was calculated. The author states that the nitrogen gained represents a gain of 1.5 pounds of flesh. The feeding experiments are discussed at length in the original publication.

Nos. 2322 and 2323 were made by Emery and Kilgore at the Agricultural Experiment Station in North Carolina in 1890 and 1891, in connection with a study of the digestibility of cotton-seed hulls. The subject was a Jersey cow. The food consumed consisted of cotton-seed meal and cotton-seed hulls. The composition of the food and feces was determined, as well as the dry matter, nitrogen, phosphoric acid and potash in the urine.

The conclusions drawn have to do with the special question under consideration.

Nos. 2324 and 2325 and Nos. 3454–3459, Table, 37 were made by Snyder at the University of Minnesota in 1893, in connection with a study of the digestibility of a number of feeding stuffs by milch cows and growing pigs. The composition of the food and feces was determined, as well as the nitrogen in the urine.

The conclusions drawn from the experiments have to do with the digestibility of the rations consumed and the gains in weight of the animals.

Nos. 2326–2339, 2340–2347, and 2402–2442 were made by Henneberg and associates at the Experiment Station at Weende in 1858–1864, as part of an extended study of the feeding of ruminants. The questions studied were (1) a maintenance ration for full-grown cattle; (2) feeding value of beet molasses and the digestibility of wood fiber; (3) feeding experiments with various kinds of coarse fodders; (4) feeding experiments with various foods added to a ration of wheat straw and clover hay (including experiments with molasses); and (5) digestibility of coarse fodder without bean meal and with the addition of a small quantity of it. The subjects of these experiments were steers weighing about 600 kilograms. The food, urine, and feces were analyzed. This series of experiments forms one of the most extended and valuable investigations which have been made on the feeding of cattle. The conclusions reached usually have to do with the special questions studied, and are not quoted in detail.

Nos. 2348–2401 were made by Grouven at the Experiment Station at Salzmunde in 1861–1863. They form part of a very extended study of metabolism. The subjects were steers. The water, fat, ash, crude fiber, nitrogen, carbon, and hydrogen in the food and feces, and in some instances the ammonia in the feces, and the specific gravity, dry matter, ash, free and combined carbon dioxid, hippuric acid, urea, nitrogen, carbon, and hydrogen in the urine were determined. The soda lime method was used for determining nitrogen. A number of special questions were studied.

In Nos. 2348–2351 the object was to see if nitrogen equilibrium could be reached when a maintenance ration of hay was consumed for a long time. The experiment lasted from December 1 to January 15, and was divided into four periods of 6, 8, 10, and 12 days, respectively. The time from December 28 to January 6 is not included in the table, as the urine and feces were not analyzed. The daily ration consumed during this time was 6,500 grams hay, and, in the author's opinion, nitrogen equilibrium was then reached, since in the preceding period there was a small loss of nitrogen and a gain in the following period. The total nitrogen consumed in experiments Nos. 2348 and 2349 was 2,594.2 grams, and the total amount excreted in urine and feces 2,617.3 grams, a difference of only 23.1 in 18 days. This experiment is regarded by Grouven as proof that there is no excretion of nitrogen in the gaseous excretory products, and also as confirming Bischoff and Voit's theory that the amount of protein metabolized increases with an increased consumption of it. Other conclusions regarding digestibility, etc., were drawn.

In Nos. 2352–2357 the object was to study metabolism during fasting. The intestinal tract of an ox retains food for several days. In the author's opinion the real fasting does not begin until the fifth day after the last food is consumed. From the (calculated) muscular tissue, fat, and mineral matter metabolized and the (calculated) heat produced, the author calculates by comparison the nutritive value of straw.

The object of Nos. 2358–2378 was to determine the nutritive value of straw. The ration consisted of straw with a little salt. The balance of nitrogen and ash was determined and the balance of carbon, oxygen, and hydrogen calculated. The

amount of these elements in the respiratory products was obtained by subtracting the amount excreted in urine and feces from the (calculated) amount consumed in food and tissue. The results of these experiments were compared with those obtained when no food was consumed. It was found that straw protected much more protein than its content of digestible protein would indicate possible. [At the time these experiments were made the theory of the isodynamical value of the nutrients was not understood, and it was not known that fat and carbohydrates can protect protein. Grouven, however, thought it possible that, when fasting, the inspired oxygen acted more energetically on the protein tissues than when straw was consumed; i. e., that the nitrogen-free constituents of the straw used up the energy of the oxygen and thus protected protein. This is almost an expression of the theory which has since become current.]

In all these experiments there are very extended discussions of the results and of various theories.

In Nos. 2379–2401 the object was to determine the influence of cane sugar, grape sugar, starch, dextrin, wood gum (*Gummi*), wax, alcohol, crude fiber from straw and "paper fiber,"[1] and of pectin upon metabolism. Each of these substances was fed with straw and the results compared with those obtained with a diet of straw alone. The conclusion was reached that all these nitrogen-free substances (except wax and alcohol) diminished the normal metabolism of muscular tissue. As the amount consumed increased, the power to protect protein diminished. The intensity of the processes of oxidation in blood and tissue is not dependent on the nitrogenous food. Such substances when supplied are metabolized instead of fatty tissue of the body. A considerable number of experiments are reported by the author which are of a different nature from those included in the present compilation, or which do not contain all the factors necessary for expressing a balance of income and outgo.

In a number of experiments the carbon dioxid in the respiratory products was determined with a respiration apparatus somewhat similar to that of Pettenkofer and Voit. Complete metabolism experiments in which this apparatus was used are not recorded in the "Zweiter Berichte." However, four experiments with a steer weighing 550 kilograms are recorded in detail, in which the carbon dioxid produced was measured, though the food, urine, and feces were not analyzed. The first experiment was of 12 hours' duration. The ration (which had also been followed for the 5 days preceding the experiment) consisted of 4,000 grams straw and about 50 grams salt. The carbon dioxid produced was 2,295 grams, or at the rate of 4,590 grams in 24 hours. In the second experiment, of the same duration and with the same ration, 2,234.5 grams carbon dioxid was produced, or at the rate of 4,469 grams in 24 hours. In the third experiment, the ration (used for 1 day before the experiment also) consisted of 4,000 grams chopped straw, 50 grams salt, and 2,500 grams cane sugar. The time was 8 hours, and 1,503.5 grams carbon dioxid was produced, or at the rate of 4,510.5 grams in 24 hours. The time of the fourth experiment was 8 hours and the ration the same as in the third. The amount of carbon dioxid produced was 1,612 grams, or at the rate of 4,836 grams in 24 hours.

Grouven believed with Bischoff and Voit that no nitrogen was excreted except in the urine and feces. The opinion was held by many that nitrogen was excreted in the respiratory products in the form of ammonia. A large number of experiments of 12 hours' duration were made with steers and other animals, using a large respiration apparatus, and the ammonia in the respiratory products was determined. The amount found was very small, not exceeding 1 gram per day for a steer weighing 650 kilograms. The quantity is so small that it can be left out of account in determining the nitrogen balance.

Nos. 2402–2442. See Nos. 2326–2339.

Nos. 2443–2446 were made by Emery and Kilgore at the Agricultural Experiment Station in North Carolina in 1895 in connection with a study of the digestibility of cotton-seed hulls and cotton-seed meal by steers. The experiments were made

[1] Paper pulp, such as was used for making writing paper.

with 3 steers. The rations consisted of cotton-seed hulls and cotton-seed meal in varying proportions. The food, urine, and feces were analyzed. The phosphoric acid, potash, and nitrogen in the excretory products were determined in connection with a study of the manurial value of the rations.

The conclusions drawn have to do with the special questions studied.

EXPERIMENTS WITH DOGS.

INFLUENCE OF FEEDING.

About one-half of the total number of experiments with animals included in the present compilation were made with dogs. As previously noted, dogs are particularly well suited for experimental purposes. They readily adapt themselves to the experimental conditions and are seldom affected by a monotonous diet; that is, a diet consisting of one food or a limited number of food materials. In experiments with man such a diet often becomes distasteful, and digestive disorders result. The range of size in dogs is such that a subject can readily be selected suitable for the special point to be studied in an experiment, and it is a comparatively easy matter to collect the urine and feces.

Owing to their limited number, in the experiments with animals, fewer subdivisions have been made in this compilation than in the experiments with man. Of the total number of experiments with dogs, 302 are included in Table 28. This section includes the tests in which the subjects were in health and the experimental conditions were not abnormal or unusual. A very few experiments under other conditions, made for purposes of comparison, are, however, included in this section.

In a number of cases the influence on metabolism of consuming milk, meat, peptones, gelatin, or other special food was studied. The digestibility of several foods was also investigated. In many cases the excretion of phosphoric acid or other mineral matter was the special question considered. Some of the investigations were carried on to study experimental methods and theories relating to the general laws of nutrition. A case in point is the work which has been done to determine whether, generally speaking, all nitrogen is excreted in the urine and feces or whether some leaves the body in the gaseous excretory products. This was a disputed point for many years, although it is now usually conceded that the former view is correct.

Another question of interest from a theoretical standpoint is the direct source of the nitrogen of the urine; that is, whether it is derived directly from the food or whether the nitrogen consumed must form a portion of the tissue of the body before it is excreted. Directly connected with this is the discussion concerning the length of time which must elapse before the nitrogen of a particular diet will be excreted. The subject, as a whole, has a direct bearing on the effect of muscular exertion on the excretion of nitrogen and the source of muscular energy in the organism.

TABLE 28.—*Experiments with dogs. Influence of feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2447	1853	Bischoff	Dog	17	500 gm. meat, 445.8 cc. water, 50 cc. sodium chlorid solution.	12	15.1	13.3	(0.3)	+ 1.5	
2448	1856	Hoppe-Seyler	Dog	6	517 gm. meat, 18 gm. water	7	12.6	9.6	1.1	+ 1.9	
2449	1856	....do	....do	....	506 gm. meat, 113 gm. cane sugar, 189 gm. water.	7	12.3	5.9	0.9	+ 5.5	
2450	1857	Voit	Dog	34.8	1,149 gm. meat	3	39.1	38.5	0.9	— 0.3	
2451	1857	....do	....do	35.6	1,186.9 gm. meat	3	40.3	39.5	0.8	0.0	
2452	1857	....do	....do	37.2	1,769.8 gm. meat	3	60.2	58.2	1.1	+ 0.9	
2453	1857	....do	Dog	27.5	1,328.9 gm. meat, 342.3 cc. water	3	45.2	44.0	1.1	+ 0.1	The nitrogen in the urine does not include 0.5 gm. from gall.
2454	1857	....do	Dog	27.7	1,500 gm. meat, 438.3 cc. water	4	51.0	49.4	2.2	— 0.6	The nitrogen in the urine does not include 0.5 gm. from gall.
2455	1860	Bischoff and Voit.	Dog	31.8	1,800 gm. meat	4	61.2	57.8	0.6	+ 2.8	
2456	1860	....do	Dog	38.7	....do	10	61.2	59.6	0.7	+ 0.9	
2457	1860	....do	Dog	34.3	....do	7	61.2	56.5	1.0	+ 3.7	
2458	1860	....do	....do	34.9	1,500 gm. meat	2	51.0	50.6	0.8	— 0.4	
2459	1860	....do	....do	34.9	1,200 gm. meat	2	40.8	41.3	0.6	— 1.1	
2460	1860	....do	....do	34.8	900 gm. meat	2	30.6	36.6	0.5	— 6.5	
2461	1860	....do	....do	34.5	600 gm. meat	2	20.4	22.9	0.2	— 2.7	
2462	1860	....do	Dog	37.6	500 gm. meat	4	17.0	16.9	0.8	— 0.7	
2463	1860	....do	Dog	35.9	....do	3	17.0	18.4	0.6	— 2.0	
2464	1860	....do	Dog	34.0	300 gm. meat	2	10.2	15.2	0.2	— 5.2	
2465	1860	....do	Dog	33.3	176 gm. meat	2	6.0	12.5	0.0	— 6.5	
2466	1860	....do	Dog	32.3	2,500 gm. meat	3	85.0	80.6	0.8	+ 3.6	
2467	1860	....do	....do	28.3	2,000 gm. meat	2	68.0	70.8	0.6	— 3.4	
2468	1860	....do	Dog	32.8	....do	3	68.0	59.3	0.6	+ 8.1	
2469	1860	....do	Dog	38.2	2,096 gm. meat	10	71.3	70.8	1.7	— 1.2	
2470	1860	....do	Dog	40.0	2,020 gm. meat	5	68.7	58.1	1.3	+ 9.3	
2471	1860	....do	Dog	32.6	150 gm. meat, 250 gm. fat	10	5.1	7.3	0.7	— 2.9	
2472	1860	....do	....do	28.2	250 gm. meat, 250 gm. fat	2	8.5	8.5	0.6	— 0.6	
2473	1860	....do	Dog	31.0	500 gm. meat, 250 gm. fat	2	17.0	14.1	0.7	+ 2.2	
2474	1860	....do	Dog	39.9	....do	3	17.0	17.2	0.8	— 1.0	
2475	1860	....do	Dog	34.4	1,000 gm. meat, 250 gm. fat	3	34.0	28.3	1.1	+ 4.6	
2476	1860	....do	Dog	36.4	1,500 gm. meat, 250 gm. fat	4	51.0	45.9	1.0	+ 4.1	
2477	1860	....do	Dog	34.8	2,000 gm. meat, 250 gm. fat	3	68.0	63.5	0.6	+ 3.9	
2478	1860	....do	Dog	39.6	1,800 gm. meat, 250 gm. fat	7	61.2	56.4	0.7	+ 4.1	
2479	1860	....do	....do	38.1	1,500 gm. meat, 150 gm. fat	2	51.0	50.8	0.0	+ 0.2	
2480	1860	....do	....do	38.7	1,000 gm. meat, 150 gm. fat	3	34.0	34.3	0.6	— 0.9	
2481	1860	....do	....do	40.2	700 gm. meat, 150 gm. fat	5	23.8	25.9	0.6	— 2.7	

2482	1860	.....do	.....do	39.0	400 gm. meat, 150 gm. fat	2	13.6	16.1	0.3	— 2.8	
2483	1860	.....do	Dog	30.2	176 gm. meat, 50 gm. fat	3	6.0	6.9	0.4	— 1.3	
2484	1860	.....do	.....do	29.1	176 gm. meat, 250 gm. fat	1	6.0	7.6	0.8	— 2.4	
2485	1860	.....do	Dog	37.5	1,500 gm. meat, 350 gm. fat	3	51.0	48.8	0.4	+ 1.8	
2486	1860	.....do	.....do	39.9	340 gm. fat	2	0.0	6.7	0.0	— 6.7	
2487	1860	.....do	Dog	30.3	176 gm. meat, 15.5 gm. fat, 150 gm. starch	2	6.0	7.7	0.5	— 2.2	
2488	1860	.....do	.....do	30.4	176 gm. meat, 24.8 gm. fat, 364 gm. starch	2	6.0	5.9	0.9	— 0.8	
2489	1860	.....do	Dog	40.9	700 gm. meat, 11.5 gm. fat, 150 gm. starch	1	23.8	26.1	0.5	— 2.8	
2490	1860	.....do	Dog	34.5	2,000 gm. meat, 5 gm. fat, 260 gm. starch	5	68.0	59.9	1.0	+ 7.1	
2491	1860	.....do	.....do	35.5	500 gm. meat, 250 gm. fat, 250 gm. starch	5	17.0	18.3	0.7	— 2.0	
2492	1860	.....do	Dog	30.2	23.6 gm. fat, 200 gm. starch	2	0.0	6.0	0.0	— 6.0	
2493	1860	.....do	Dog	40.6	21.3 gm. fat, 450 gm. starch	2	0.0	5.7	0.0	— 5.7	
2494	1860	.....do	Dog	34.1	856.6 gm. bread	6	11.0	14.0	2.2	— 5.2	
2495	1860	.....do	.....do	34.4	773.2 gm. bread	41	9.9	11.5	1.5	— 3.1	
2496	1860	.....do	Dog	28.7	150 gm. meat, 100 gm. grape sugar	1	5.1	6.4	0.5	— 1.8	
2497	1860	.....do	.....do	28.5	150 gm. meat, 350 gm. grape sugar	3	5.1	6.2	1.8	— 1.9	
2498	1860	.....do	Dog	36.5	500 gm. meat, 300 gm. grape sugar	3	17.0	15.3	0.6	+ 1.1	
2499	1860	.....do	.....do	36.5	500 gm. meat, 200 gm. grape sugar	3	17.0	16.6	0.6	— 0.2	
2500	1860	.....do	.....do	36.2	500 gm. meat, 100 gm. grape sugar	3	17.0	17.7	0.6	— 1.3	
2501	1860	.....do	Dog	41.0	750 gm. meat, 150 gm. grape sugar	1	25.5	31.1	0.7	— 6.3	
2502	1860	.....do	Dog	34.9	2,000 gm. meat, 200 gm. grape sugar	3	68.0	62.7	1.7	+ 3.6	
2503	1860	.....do	.....do	33.2	2,000 gm. meat, 166 gm. milk sugar	3	68.0	59.5	1.7	+ 6.8	
2504	1860	.....do	Dog	40.5	435 gm. grape sugar	2	0.0	8.0	0.4	— 8.4	
2505	1860	.....do	Dog	32.4	200 gm. meat, 200 gm. gelatin	3	34.9	42.4	0.9	— 8.4	
2506	1860	.....do	.....do	31.6	200 gm. meat, 300 gm. gelatin	2	49.0	50.5	1.1	— 2.6	
2507	1860	.....do	Dog	40.4	1,200 gm. meat, 100 gm. gelatin	1	54.9	52.3	0.8	+ 1.8	
2508	1860	.....do	.....do	40.2	400 gm. meat, 300 gm. gelatin	2	55.8	51.5	0.3	+ 4.0	
2509	1860	.....do	Dog	32.8	2,000 gm. meat, 200 gm. gelatin	3	96.1	54.2	1.2	+40.7	
2510	1860	.....do	Dog	36.9	500 gm. meat, 200 gm. gelatin	3	45.1	42.5	1.1	+ 1.5	
2511	1860	.....do	.....do	36.8	200 gm. gelatin	3	28.1	30.7	0.3	— 2.9	
2512	1860	.....do	.....do	36.4	200 gm. gelatin, 200 gm. fat	3	28.1	29.4	0.5	— 1.8	
2513	1860	.....do	.....do	35.1	100 gm. gelatin, 200 gm. fat	3	14.1	17.0	0.5	— 3.4	
2514	1860	.....do	.....do	36.0	50 gm. gelatin, 200 gm. fat	3	7.0	13.3	0.4	— 6.7	
2515	1866	Voit	Dog	....	480 gm. meat	3	16.3	16.4	0.4	— 0.5	
2516	1866	.....do	.....do	....	800 gm. meat	6	27.2	27.6	0.5	— 0.9	
2517	1866	.....do	.....do	....	1,500 gm. meat	49	51.0	50.9	0.6	— 0.5	
2518	1866	.....do	.....do	....	.....do	6	51.0	50.7	0.7	— 0.4	Ash in food, 18.8 gm.; in urine, 16.2 gm.; in feces, 2.9 gm.; loss, 0.3 gm.
2519	1866	.....do	.....do	....	.....do	9	51.0	50.4	0.8	— 0.2	Ash in food, 18.7 gm.; in urine, 16.1 gm.; in feces, 2.9 gm.; loss, 0.3 gm.
2520	1866	.....do	.....do	....	.....do	11	51.0	49.8	0.6	+ 0.6	Ash in food, 18.7 gm.; in urine, 15.9 gm.; in feces, 2.5 gm.; gain, 0.3 gm.
2521	1866	.....do	.....do	....	.....do	6	51.0	50.7	0.5	— 0.2	Ash in food, 18.8 gm.; in urine, 16.2 gm.; in feces, 1.8 gm.; gain, 0.8 gm.
2522	1866	.....do	.....do	....	.....do	12	51.0	50.3	0.7	0.0	Ash in food, 18.8 gm.; in urine, 16.1 gm.; in feces, 2.5 gm.; gain, 0.2 gm.
2523	1866	.....do	.....do	....	.....do	13	51.0	49.8	0.6	+ 0.6	
2524	1866	.....do	.....do	....	.....do	14	51.0	50.8	0.5	— 0.3	
2525	1866	.....do	.....do	....	.....do	23	51.0	50.6	0.6	— 0.2	Ash in food, 18.7 gm.; in urine, 16.2 gm.; in feces, 2.0 gm.; gain, 0.5 gm.
2526	1866	.....do	.....do	....	1,784 gm. meat	5	60.6	59.4	0.9	+ 0.3	Ash in food, 22.3 gm.; in urine, 19.0 gm.; in feces, 3.3 gm.; gain or loss, 0.

TABLE 28.—*Experiments with dogs. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. In milk.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2527	1866	Voit	Dog		1,800 gm. meat	5	61.2	59.0	0.9		+ 1.3	Ash in food, 22.5 gm.; in urine, 18.9 gm.; in feces, 3.3 gm.; gain, 0.3 gm.
2528	1866	do	do		do	7	61.2	59.6	0.7		+ 0.9	
2529	1866	do	do		2,000 gm. meat	8	68.0	67.2	0.8		0.0	Ash in food, 25.0 gm.; in urine, 21.5 gm.; in feces, 3.0 gm.; gain, 0.5 gm.
2530	1866	do	do		do	5	68.0	66.4	0.6		+ 1.0	
2531	1866	do	do		2,200 gm. meat	3	74.8	72.2	1.4		+ 1.2	Ash in food, 27.5 gm.; in urine, 23.1 gm.; in feces, 4.8 gm.; loss, 0.4 gm.
2532	1866	do	do		do	4	74.8	72.4	1.4		+ 1.0	Ash in food, 27.5 gm.; in urine, 23.1 gm.; in feces, 4.8 gm.; loss, 0.4 gm.
2533	1866	do	do		2,500 gm. meat	1	85.0	85.8	0.7		— 1.5	
2534	1866	do	do		do	1	85.0	84.4	1.0		— 0.4	Ash in food, 31.2 gm.; in urine. 27.0 gm.; in feces, 3.5 gm.; gain, 0.7 gm.
2535	1866	do	do		500 gm. meat, 200 gm. fat	3	17.0	16.5	0.5		0.0	
2536	1866	do	do		500 gm. meat, 100 gm. fat	20	17.0	16.4	0.4		+ 0.2	
2537	1866	do	do		500 gm. meat, 200 gm. fat	58	17.0	16.3	0.7		0.0	
2538	1866	do	do		800 gm. meat, 200 gm. fat	5	27.2	25.9	0.8		+ 0.5	
2539	1866	do	do		1,000 gm. meat, 150 gm. fat	3	34.0	34.2	0.5		— 0.7	
2540	1866	do	do		1,400 gm. meat, 150 gm. fat	3	47.6	46.9	0.5		+ 0.2	
2541	1866	do	do		1,500 gm. meat, 30 gm. fat	8	51.0	49.8	0.6		+ 0.6	
2542	1866	do	do		1,500 gm. meat, 60 gm. fat	3	51.0	50.1	0.8		+ 0.1	
2543	1866	do	do		1,500 gm. meat, 150 gm. fat	8	51.0	50.0	1.0		0.0	
2544	1866	do	do		1,800 gm. meat, 250 gm. fat	2	61.2	60.1	0.7		+ 0.4	
2545	1866	do	do		500 gm. meat, 200 gm. sugar	3	17.0	16.6	0.6		— 0.2	
2546	1866	do	do		1,100 gm. meat, 100 gm. gelatin	1	51.4	51.6	0.5		— 0.7	
2547	1866	do	Dog		1,000 gm. meat, 303.7 gm. milk, coffee (24 days)	48	36.0	35.7	0.6		— 0.3	
2548	1866	do	do		Bread (ad libitum), 303.7 gm. milk, coffee (21 days).	42	9.9	8.5	1.4		0.0	
2549	1866	do	Dog	20.0	1,000 gm. meat	6	34.0	33.8	0.5		— 0.3	
2550	1866	do	do		350 gm. meat, 150 gm. fat	4	11.9	11.4	0.4		+ 0.1	
2551	1866	do	do		Bread (ad libitum)	3	13.5	10.2	3.1		+ 0.2	
2552	1866	do	do		200 gm. meat, 200 gm. gelatin	3	34.9	34.1	0.4		+ 0.4	
2553	1866	do	Dog No. 5	3.0	300 gm. meat	9	10.2	9.7	0.3		+ 0.2	
2553*a*	1866	do	do	2.9	300 gm. meat, 6.7 gm. urea	9	13.3	12.9	0.3		+ 0.1	
2554	1866	do	do		300 gm. meat	2	10.2	10.1	0.2		— 0.1	
2555	1867	E. Bischoff	Dog		2,000 gm. meat	8	68.0	67.2	0.9		— 0.1	P_2O_5 in food, 8.9 gm.; in urine, 8.2 gm.; in feces, 0 7 gm.; gain or loss, 0.

2556	1867	....do......	.....do	....	1,500 gm. meat	17	51.8	51.0	0.8	......	0.0	P_2O_5 in food, 6.7 gm.; in urine, 6.1 gm.; in feces, 0.5 gm.; gain, 0.1 gm.
2557	1867	....do......	.....do	....	.....do	4	51.0	46.2	0.5	......	+ 4.3	P_2O_5 in food, 6.7 gm.; in urine, 5.9 gm.; in feces, 0.4 gm.; gain, 0.4 gm.
2558	1867	....do......	.....do	....	.....do	8	51.0	47.7	0.5	......	+ 2.8	P_2O_5 in food, 6.7 gm.; in urine, 5.8 gm.; in feces, 0.4 gm.; gain, 0.5 gm.
2559	1867	....do......	.....do	....	.....do	3	51.0	55.9	0.7	......	— 5.6	P_2O_5 in food, 6.7 gm.; in urine, 7.1 gm.; in feces, 0.5 gm.; loss, 0.9 gm.
2560	1867	....do......	.....do	....	1,000 gm. meat	6	34.0	36.2	0.6	......	— 2.8	P_2O_5 in food, 4.5 gm.; in urine, 4.4 gm.; in feces, 0.4 gm.; loss, 0.3 gm.
2561	1867	....do......	.....do	....	500 gm. meat	8	17.0	19.3	0.3	......	— 2.6	P_2O_5 in food, 2.2 gm.; in urine, 2.3 gm.; in feces, 0.2 gm.; loss, 0.3 gm.
2562	1867	....do......	.....do	....	1,500 gm. meat, 30 gm. fat	8	51.0	49.8	0.6	......	+ 0.6	P_2O_5 in food, 6.7 gm.; in urine, 6.1 gm.; in feces, 0.4 gm.; gain, 0.2 gm.
2563	1867	....do......	.....do	....	1,500 gm. meat, 100 gm. fat	7	51.0	48.4	0.6	......	+ 2.0	P_2O_5 in food, 6.7 gm.; in urine, 5.8 gm.; in feces, 0.4 gm.; gain, 0.5 gm.
2564	1867	....do......	.....do	....	400 gm. meat, 400 gm. starch	7	13.6	15.7	0.8	......	— 2.9	P_2O_5 in food, 2.3 gm.; in urine, 2.3 gm.; in feces, 0.4 gm.; loss, 0.4 gm.
2565	1867	....do......	.....do	....	500 gm. meat, 250 gm. starch	6	17.0	17.8	0.5	......	— 1.3	P_2O_5 in food, 2.5 gm.; in urine, 2.4 gm.; in feces, 0.4 gm.; loss, 0.3 gm.
2566	1867	....do......	.....do	....	900 gm. bread	6	11.5	10.6	2.0	......	— 1.1	P_2O_5 in food, 3.5 gm.; in urine, 2.8 gm.; in feces, 0.8 gm.; loss, 0.1 gm.
2567	1867	....do......	.....do	....	500 gm. starch	2	0.0	5.1	0.7	......	— 5.8	P_2O_5 in food, 0.6 gm.; in urine, 1.1 gm.; in feces, 0.5 gm.; loss, 1.0 gm.
2568	1867	....do......	.....do	....	Fasting	6	0.0	6.9	0.2	......	— 7.1	P_2O_5 in food, 0; in urine, 1.1 gm.; in feces, 0.1 gm.; loss, 1.1 gm.
2569	1869	Voit........	Dog (female)	34.5	2,000 gm. meat, 1,000 gm. water	1	68.0	56.0	1.3	......	+10.7	
2570	1869	....do......	.....do	34.5	.....do	1	68.0	59.0	1.3	......	+ 7.7	
2571	1869	....do......	.....do	34.5	1,000 gm. meat, 300 gm. starch, 1,225 gm. water	1	34.0	39.0	1.3	......	— 7.3	
2572	1869	....do......	.....do	34.8	1,000 gm. meat, 300 gm. starch, 778 gm. water	1	34.0	39.0	0.9	1.1	— 7.0	
2573	1869	....do......	.....do	34.2	1,000 gm. meat, 200 gm. fat, 630 gm. water	1	34.0	28.0	1.1	1.4	+ 3.5	
2574	1869	....do......	.....do	34.2	1,000 gm. meat, 200 gm. fat, 663 gm. water	1	34.0	28.0	1.1	1.1	+ 3.8	
2575	1869	....do......	.....do	35.0	500 gm. meat, 400 gm. starch, 877 gm. water	1	17.0	23.0	1.2	1.2	— 8.4	
2576	1869	....do......	.....do	34.5	500 gm. meat, 300 gm. fat, 595 gm. water	1	17.0	16.0	1.2	1.6	— 1.8	
2577	1869	....do......	.....do	34.3	Fasting, 358 gm. water	1	0.0	10.0	0.0	1.5	—11.5	
2578	1869	....do......	.....do	33.3	Fasting, 405 gm. water	1	0.0	8.0	0.0	1.0	— 9.0	
2579	1869	....do......	.....do	32.7	500 gm. starch, 216 gm. water	1	0.0	7.0	0.9	1.1	— 9.0	
2580	1869	....do......	.....do	34.8	2,000 gm. meat, 887 gm. water	1	68.0	59.0	0.7	1.6	+ 6.7	
2581	1869	....do......	.....do	34.3	2,000 gm. meat, 892 gm. water	1	68.0	64.0	0.7	1.7	+ 2.6	
2582	1869	E. Bischoff	Dog	30.0	800 gm. bread	19	10.2	10.7	1.7	......	— 2.2	
2583	1869	....do......	.....do	....	800 gm. bread, 20 gm. meat extract	20	12.4	11.2	2.1	......	— 0.9	
2584	1869	....do......	.....do	....	800 gm. bread	19	10.2	9.4	1.7	......	— 0.9	
2585	1869	....do......	.....do	....	800 gm. bread, 100 gm. meat	15	13.6	11.0	2.2	......	+ 0.4	
2586	1869	....do......	.....do	....	800 gm. bread	14	10.2	9.4	1.5	......	— 0.7	
2587	1869	....do......	.....do	....	800 gm. bread, 5 gm. meat extract	14	10.9	9.7	2.0	......	— 0.8	
2588	1869	....do......	.....do	....	800 gm. bread, 5 gm. meat extract, 3 gm. salt	12	10.9	10.4	1.8	......	— 1.3	
2589	1869	....do......	.....do	....	800 gm. bread	19	10.2	9.0	1.6	......	— 0.4	
2590	1869	....do......	.....do	....	354 gm. starch, 302 gm. meat	16	10.3	9.4	0.8	......	+ 0.1	
2591	1869	Voit (reported by E. Bischoff).	.....do	....	1,054 gm. bread	3	13.5	10.2	3.1	......	+ 0.2	

TABLE 28.—*Experiments with dogs. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2592	1871	Toldt (reported by Seegen).	Dog		1,200 gm. meat, 1,000 cc. water	40	40.8	39.1	0.5	+ 1.2	
2593	1873	Forster	Dog	26	170 gm. meat residue, 150 gm. fat, — gm. starch.	33	15.5	16.4	0.9	— 1.8	P_2O_5 in food, 0.6 gm.; in urine and feces, 1.3 gm.; loss, 0.7 gm. Iron in food, 0.2 gm.; in urine, 0 gm.; in feces, 0.9 gm.; loss, 0.7 gm. (Average of 38 days.)
2594	1873	do	Dog	32	— gm. meat residue	26	22.2	23.0	1.6	— 2.4	P_2O_5 in food, 0.9 gm.; in urine 1.7 gm.; in feces, 0.5 gm.; loss, 1.3 gm. Iron in food, 0.4 gm.; in urine and feces, 0.9 gm.; loss, 0.5 gm.
2595	1873	do	do		187.5 gm. meat residue, 150 gm. fat, 37.5 gm. starch.	8	25.9	24.7	0.9	+ 0.3	First to eighth day of No. 2594.
2596	1873	do	do		163.9 gm. meat residue, 81.2 gm. fat	8	23.7	23.5	1.9	— 1.7	Ninth to seventeenth day of No. 2594.
2597	1873	do	do		156.1 gm. meat residue, 86.1 gm. fat, 82.9 gm. starch.	8	22.6	22.8	2.0	— 2.2	Eighteenth to twenty-sixth day of No. 2594.
2598	1874	Voit	Dog		Fasting (800 gm. water)	5	0.0	11.8	0.0	—11.8	
2599	1874	do	do		1,081.9 gm. ossein, 50 gm. fat, 800 gm. water.	3	56.5	53.2	3.2	+ 0.1	
2600	1874	do	do		Fasting (800 gm. water)	3	0.0	18.5	0.0	—18.5	
2601	1875	Plósz and Gyergyai.	Dog	2.7	465 gm. peptone, 198 cc. solution of grape sugar, starch, and butter.	6	2.4	2.3		+ 0.1	
2602	1880	Gruber	Dog	17.5	600 gm. meat, 200 cc. water	5	21.3	19.2	0.3	+ 0.8	Nitrogen in food calculated; in urine determined by the Liebig method.
2603	1880	do	do		do	5	21.3	19.9	0.3	+ 1.1	Same test as No. 2602. Nitrogen in food calculated; in urine determined by Voit method.
2604	1880	do	do		do	7	22.1	21.8	0.3	0.0	Nitrogen in food determined by Dumas method; in urine determined by Voit method.
2605	1880	do	do		do	7	22.0	21.8	0.3	— 0.1	Same test as No. 2604. Nitrogen in food determined by Will method; in urine by Voit method.
2606	1880	do	do		do	7	21.3	21.2	0.3	— 0.2	Same test as No. 2604. Nitrogen in food calculated; in urine determined by Liebig method.
2607	1880	do	do		do	7	21.3	21.8	0.3	— 0.8	Same test as No. 2604. Nitrogen in food calculated; in urine determined by Voit method.

2608	1880	....do	....do	....	....do	7	22.1	21.2	0.3	— 0.4	Same test as No. 2604. Nitrogen in food determined by Dumas method; in urine determined by Liebig method.
2609	1880	....do	....do	....	....do	10	21.4	21.0	0.3	+ 0.1	Nitrogen in food determined by Dumas method; in urine determined by Voit method. S in food, 1.3 gm.; in urine, 1.2 gm.; in feces, 0.1 gm.; gain or loss, 0.
2610	1880	....do	....do	....	....do	10	21.3	21.0	0.3	0.0	Same test as No. 2609. Nitrogen in food determined by Will method; in urine determined by Voit method.
2611	1880	....do	....do	....	....do	10	21.3	21.3	0.3	— 0.3	Same test as No. 2609. Nitrogen in food calculated; in urine determined by Liebig method.
2612	1880	....do	....do	....	....do	10	21.3	21.0	0.3	0.0	Same test as No. 2609. Nitrogen in food calculated; in urine determined by Voit method.
2613	1880	....do	....do	....	....do	10	21.3	21.3	0.3	— 0.3	Same test as No. 2609. Nitrogen in food determined by Dumas method; in urine determined by Liebig method.
2614	1880	....do	....do	....	....do	7	21.4	20.8	0.3	+ 0.3	Last 7 days of No. 2609. Nitrogen in food determined by Dumas method; in urine determined by Voit method.
2615	1880	....do	....do	....	....do	7	21.3	20.8	0.3	+ 0.2	Same as No. 2614. Nitrogen in food determined by Will method; in urine determined by Voit method.
2616	1883	Gruber	Dog	19.1	500 gm. meat, 50 gm. bacon	5	18.0	17.8	0.2	0.0	
2617	1883	....do	....do	19.0	....do	7	18.8	18.8	0.2	— 0.2	
2618	1883	....do	....do	18.9	....do	2	17.9	17.9	0.2	— 0.2	
2619	1883	....do	....do	18.9	....do	8	18.1	17.7	0.2	+ 0.2	
2620	1884	Rieder	Dog	7.0	140 gm. starch, 11.3 gm. fat	4	0.0	1.6	0.2	— 1.8	
2621	1885	Rudenko	Dog	10.0	270 gm. meat, 250 gm. bread	10	13.2	10.3	1.7	+ 1.2	
2622	1885	....do	....do	10.6	270 gm. meat, 750 gm. milk	10	13.0	11.5	0.5	+ 1.0	
2623	1885	....do	....do	10.6	270 gm. meat, 661 gm. milk	9	14.6	11.5	0.5	+ 2.6	
2624	1885	....do	....do	10.7	270 gm. meat, 690 gm. milk	5	13.2	12.0	0.5	+ 0.7	
2625	1885	....do	....do	10.6	1,000 cc. milk, 28 gm. cheese	8	6.5	7.0	0.6	— 1.1	
2626	1885	....do	....do	10.7	....do	7	7.9	6.2	0.6	+ 1.1	
2627	1885	....do	....do	10.0	520 gm. meat, 38 gm. water	9	18.1	18.5	0.5	— 0.9	
2628	1885	....do	....do	10.0	1,000 cc. milk, 28 gm. cheese	9	8.0	6.2	0.8	+ 1.0	
2629	1885	....do	....do	9.9	1,000 cc. milk	6	6.1	5.6	0.8	— 0.3	
2630	1885	....do	....do	9.9	1,170 cc. milk	9	7.4	6.7	0.8	— 0.1	
2631	1885	....do	....do	9.3	1,270 cc. milk	5	7.8	6.3	0.8	+ 0.7	
2632	1885	....do	....do	9.3	1,270 cc. milk with — gm. casein mixture	4	7.8	6.4	0.5	+ 0.9	
2633	1885	....do	Dog	11.7	1,200 cc. milk	8	8.0	5.9	0.8	+ 1.3	
2634	1885	....do	....do	11.9	....do	12	7.2	6.3	0.4	+ 0.5	
2635	1885	....do	....do	....	— gm. casein mixture, 1,000 cc. water	6	9.1	6.9	0.5	+ 1.7	
2636	1885	Pollitzer	Dog	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. meat.	6	2.4	1.7	0.2	+ 0.5	Meat period.
2637	1885	....do	....do	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. peptone.	2	2.4	1.7	0.1	+ 0.6	Peptone period.

TABLE 28.—*Experiments with dogs. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Dys.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2638	1885	Pollitzer	Dog	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. meat.	3	2.4	1.7	0.2	+ 0.5	Meat period.
2639	1885	....do	....do	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. protalbumose.	2	2.5	1.7	0.1	+ 0.7	Protalbumose period.
2640	1885	....do	....do	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. heteroalbumose.	1	2.5	1.5	0.2	+ 0.8	Heteroalbumose period.
2641	1885	....do	....do	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. meat.	4	2.1	1.5	0.2	+ 0.4	Meat period.
2642	1885	....do	....do	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. gelatin.	3	2.3	2.6	0.2	— 0.5	Gelatin period.
2643	1885	....do	....do	3.5	70 gm. rice starch, 20 gm. fat, — gm. salt, — gm. meat.	4	2.1	1.5	0.2	+ 0.4	Meat period.
2644	1887	Potthast	Dog	6.8	200 gm. meat, 30 gm. fat, 30 gm. starch	3	6.7	4.7	0.8	+ 1.2	In Nos. 2644–2657 the nitrogen of the feces includes 0.1 gm. from hair.
2645	1887	....do	....do	6.9	200 gm. meat, 20 gm. fat, 55 gm. starch	8	6.8	4.5	0.8	+ 1.5	
2646	1887	....do	....do	7.0	190 gm. lentils, 1 gm. fat	9	7.6	4.8	2.1	+ 0.7	
2647	1887	....do	....do	7.2	42.5 gm. meat meal, 45 gm. starch	7	5.2	4.6	0.4	+ 0.2	
2648	1887	....do	....do	7.0	39.5 gm. casein, 5 gm. fat, 45 gm. starch	6	4.5	4.6	0.6	— 0.7	
2649	1887	....do	....do	6.8	42.5 gm. meat meal, 45 gm. starch	6	5.2	4.8	0.5	— 0.1	
2650	1887	....do	....do	6.6	47 gm. gluten, 5 gm. fat, 36 gm. starch	7	5.2	5.2	0.5	— 0.5	
2651	1887	....do	....do	6.4	53.4 gm. lupines, 41 gm. starch	7	5.4	5.8	0.4	— 0.8	
2652	1887	....do	....do	6.3	42.5 gm. meat meal, 45 gm. starch	6	5.2	5.1	0.7	— 0.6	
2653	1887	....do	....do	6.1	42.5 gm. meat meal, 5 gm. fat, 45 gm. starch	5	5.2	4.9	0.7	— 0.4	
2654	1887	....do	....do	6.0	42.5 gm. meat meal, 59.8 gm. starch	4	5.2	4.6	0.7	— 0.1	
2655	1887	....do	....do	6.0	42.5 gm. meat meal, 58.8 gm. starch	5	5.3	4.6	0.7	0.0	
2656	1887	....do	....do	6.0	46.9 gm. casein, 54 gm. starch	6	5.2	4.5	0.2	+ 0.5	
2657	1887	....do	....do	6.0	42.5 gm. casein, 58.8 gm. starch	5	5.2	4.5	0.7	0.0	
2658	1887	Constantinidi	Dog	24.0	100 gm. wheat gluten, 100 gm. bacon	3	12.5	11.7	0.4	+ 0.4	
2659	1887	....do	....do	24.0	200 gm. wheat gluten, 50 gm. bacon, 2.5 gm. salt.	5	26.9	24.2	0.7	+ 2.0	
2660	1888	Kolpakcha	Dog	17.8	600 gm. meat	4	21.0	20.3	0.6	+ 0.1	P_2O_5 in food, 2.9 gm.; in urine, 2.8 gm.; in feces, 0.2 gm.; loss, 0.9.
2661	1888	....do	....do	18.1	1,200 gm. meat	4	42.0	35.9	0.6	+ 5.5	P_2O_5 in food, 5.7 gm.; in urine, 4.7 gm.; in feces, 0.4 gm.; loss, 2.4 gm.
2662	1888	....do	....do	18.7	1,800 gm. meat	2	62.9	52.2	1.5	+ 9.2	P_2O_5 in food, 8.6 gm.; in urine, 6.9 gm.; in feces, 0.9 gm.; gain, 0.8 gm.
2663	1888	....do	....do	18.6	Fasting	6	0.0	6.0	0.1	— 6.1	P_2O_5 in food, 0; in urine, 1.1 gm.; in feces, 0; loss, 1.1 gm.
2664	1888	....do	Dog	16.7	1,200 gm. meat, 200 cc. water	5	42.0	36.4	0.4	+ 5.2	P_2O_5 in food, 6.2 gm.; in urine, 5.2 gm.; in feces, 0.3 gm.; gain, 0.7 gm.

2665	1888	.....do	.....do	16.3	120 gm. starch, 20 gm. lard, 800 cc. water	9	0.0	4.3	0.5	— 4.8	P_2O_5 in food, 0; in urine, 0.8 gm.; in feces, 0.2 gm.; loss, 1.0 gm.
2666	1888	.....do	Dog	17.3	500 gm. meat, 20 gm. lard	5	17.5	17.4	0.2	— 0.1	P_2O_5 in food, 2.6 gm.; in urine, 2.5 gm.; in feces, 0.1 gm.; gain or loss, 0. S in food, 1.1 gm.; in urine, 1.1 gm.; in feces, 0; gain or loss, 0.
2667	1888	.....do	.....do	17.1	1,000 gm. white of egg, 30 gm. lard	5	20.4	20.0	0.7	— 0.3	P_2O_5 in food, 0.4 gm.; in urine, 0.5 gm.; in feces, 0; loss, 0.1 gm. S in food, 2.1 gm.; in urine, 2.0 gm.; in feces, 0; gain, 0.1 gm.
2668	1888	.....do	.....do	17.2	1,200 gm. white of egg, 30 gm. lard	2	24.5	23.6	1.1	— 0.2	P_2O_5 in food, 0.5 gm.; in urine, 0.6 gm.; in feces, 0; loss, 0.1 gm. S in food, 2.5 gm.; in urine, 2.4 gm.; in feces, 0; gain, 0.1 gm.
2669	1888	.....do	.....do	17.1	1,500 gm. white of egg, 30 gm. lard	2	30.6	26.8	1.0	+ 2.8	P_2O_5 in food, 0.6 gm.; in urine, 0.6 gm.; in feces, 0; gain or loss, 0. S in food, 3.1 gm.; in urine, 3.0 gm.; in feces, 0; gain, 0.1 gm.
2670	1888	.....do	.....do	17.2	1,700 gm. white of egg, 30 gm. lard	1	34.7	28.7	2.4	+ 3.6	P_2O_5 in food, 0.7 gm.; in urine, 0.5 gm.; in feces, 0.1 gm.; gain 0.1 gm. S in food, 3.5 gm.; in urine, 3.1 gm.; in feces, 0.1 gm.; gain, 0.3 gm.
2671	1888	.....do	.....do	17.1	2,000 gm. white of egg, 15 gm. lard	1	40.8	29.6	2.5	+ 8.7	P_2O_5 in food, 0.9 gm.; in urine, 0.4 gm.; in feces, 0; gain, 0.5 gm. S in food, 4.2 gm.; in urine, 3.1 gm.; in feces, 0.1 gm.; gain, 1.0 gm.
2672	1888	.....do	.....do	17.1	Fasting	2	0.0	10.4	0.0	—10.4	P_2O_5 in food, 0; in urine, 0.8 gm.; in feces, 0; loss, 0.8 gm. S in food, 0; in urine, 0.8 gm.; in feces, 0; loss, 0.8 gm.
2673	1888	.....do	Dog	16.4	2,580 gm. white of egg	1	52.7	26.2	2.6	+23.9	P_2O_5 in food, 1.1 gm.; in urine, 0; in feces, 0.1 gm.; gain, 1.0 gm. S in food, 5.4 gm.; in urine, 3.3 gm.; in feces, 0.1 gm.; gain, 2.0 gm.
2674	1888	.....do	.....do	17.5	2,800 gm. white of egg	1	57.1	39.0	3.2	+16.9	P_2O_5 in food, 1.2 gm.; in urine, 0.4 gm.; in feces, 0.2 gm.; gain, 0.6 gm. S in food, 5.8 gm.; in urine, 4.5 gm.; in feces, 0.1 gm.; gain, 1.2 gm.
2675	1888	.....do	.....do	16.2	Fasting. 100 to 250 cc. water (3 days)	8	0.0	5.5	0.1	— 5.6	P_2O_5 in food, 0; in urine, 0.7 gm.; in feces, 0; loss, 0.7 gm. S in food, 0; in urine, 0.5 gm. (=average of 6 days); in feces, 0; loss, 0.5 gm.
2676	1888	.....do	Dog	16.3	450 gm. meat, 50 gm. lard	5	15.4	14.6	0.7	+ 0.1	P_2O_5 in food, 2.3 gm.; in urine, 2.0 gm.; in feces, 0.3 gm.; gain or loss, 0.
2677	1888	.....do	.....do	16.2	112 gm. gelatin, 50 gm. lard	3	16.0	18.3	0.8	— 3.1	P_2O_5 in food, 0; in urine, 0.8 gm.; in feces, 0.1 gm.; loss, 0.9 gm.
2678	1888	.....do	.....do	16.1	116 gm. gelatin, 50 gm. lard	1	16.2	18.7	1.4	— 3.9	P_2O_5 in food, 0; in urine, 0.6 gm.; in feces, 0.1 gm.; loss, 0.7 gm.
2679	1888	.....do	.....do	16.1	150 gm. gelatin, 50 gm. lard	2	21.4	23.7	1.0	— 3.3	P_2O_5 in food, 0; in urine, 0.5 gm.; in feces, 0.1 gm.; loss, 0.6 gm.
2680	1888	.....do	.....do	15.9	Fasting	2	0.0	3.9	0.3	— 4.2	P_2O_5 in food, 0; in urine, 0.5 gm.; in feces, 0.

TABLE 28.—*Experiments with dogs. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2681	1888	Kolpakcha	Dog	16.7	500 gm. meat, 20 gm. lard	6	17.5	17.6	0.1	— 0.2	P_2O_5 in food, 2.6 gm; in urine, 2.6 gm.; in feces, 0.1 gm.; gain or loss, 0. S in food, 1.1 gm.; in urine, 1.0 gm.; in feces, 0; gain, 0.1 gm.
2682	1888	...do	...do	16.6	120 gm. gelatin. 40 gm. lard	2	17.1	20.0	0.7	— 3.6	P_2O_5 in food, 0; in urine, 0.9 gm.; in feces, 0.1 gm.; loss, 1.0 gm. S in food, 0.8 gm.; in urine, 1.0 gm.; in feces, 0.2 gm.; loss, 0.4 gm.
2683	1888	...do	...do	16.4	180 gm. gelatin, 40 gm. lard	3	25.7	28.8	0.7	— 3.8	P_2O_5 in food, 0; in urine, 0.5 gm.; in feces, 0.1 gm.; loss, 0.6 gm. S in food, 1.1 gm.; in urine, 1.2 gm.; in feces, 0.1 gm.; loss, 0.2 gm.
2684	1888	...do	...do	16.4	240 gm. gelatin, 40 gm. lard	1	34.2	34.8	0.6	— 1.2	P_2O_5 in food, 0; in urine, 0.3 gm.; in feces, 0.1 gm.; loss, 0.4 gm. S in food, 1.5 gm.; in urine, 1.4 gm.; in feces, 0.1 gm.; gain or loss, 0.
2685	1888	...do	...do	16.3	220 gm. gelatin, 40 gm. lard	1	31.4	32.6	0.5	— 1.7	P_2O_5 in food, 0; in urine, 0.3 gm.; in feces, 0.1 gm.; loss, 0.4 gm. S in food, 1.4 gm.; in urine, 1.3 gm.; in feces, 0.1 gm.; gain or loss, 0.
2686	1888	...do	...do	16.2	143 gm. gelatin, 20 gm. lard	1	20.4	22.4	0.5	— 2.5	P_2O_5 in food, 0; in urine, 0.3 gm.; in feces, 0.1 gm.; loss, 0.4 gm. S in food, 0.8 gm.; in urine, 0.9 gm.; in feces, 0.1 gm.: loss, 0.2 gm.
2687	1888	...do	...do	15.9	112 gm. starch, 20 gm. lard	4	0.0	2.8	0.5	— 3.3	P_2O_5 in food, 0; in urine, 0.5 gm.; in feces, 0.1 gm.; loss, 0.6 gm. S in food, 0; in urine, 0.2 gm.; in feces, 0.1 gm.; loss, 0.3 gm.
2688	1888	...do	...do	15.6	95 gm. gelatin, 20 gm. lard	1	13.5	14.3	0.4	— 1.2	P_2O_5 in food, 0; in urine, 0.2 gm.; in feces, 0.2 gm.: loss, 0.4 gm. S in food, 0.6 gm.; in urine, 0.6 gm.; in feces, 0.1 gm.; loss, 0.1 gm.
2689	1888	...do	...do	15.5	82 gm. gelatin, 20 gm. lard	1	11.7	13.9	0.4	— 2.6	P_2O_5 in food, 0; in urine, 0.3 gm.; in feces, 0.2 gm.; loss, 0.5 gm. S in food, 0.5 gm.: in urine, 0.6 gm.; in feces, 0.1 gm.; loss, 0.2 gm.

2690	1888	.....do	.....do	15.1	Fasting....................................	8	0.0	2.1	0.1	— 2.2	P_2O_5 in food, 0; in urine, 0.4 gm.; in feces, 0; loss, 0.4 gm. S in food, 0; in urine, 0.2 gm. (=average of 4 days); in feces, 0; loss, 0.2 gm.
2691	1888	.....do	Dog	14.7	1,000 gm. white of egg, 2.4 gm. disodium phosphate.	1	20.4	14.0	1.3	+ 5.1	P_2O_5 in food, 0.9 gm.; in urine, 0.6 gm.; in feces, 0.1 gm.; gain, 0.2 gm.
2692	1888	.....do	.....do	15.0	1,000 gm. white of egg, 12.5 gm. disodium phosphate.	2	20.4	18.2	1.3	+ 0.9	P_2O_5 in food, 2.9 gm.; in urine, 2.9 gm.; in feces, 0.1 gm.; loss, 0.1 gm.
2693	1888	.....do	.....do	15.3	500 gm. yolk of egg........................	4	12.8	11.1	0.4	+ 1.3	P_2O_5 in food, 6.9 gm.; in urine, 5.1 gm.; in feces, 1.1 gm.; gain, 0.7 gm.
2694	1888	.....do	.....do	15.2	Fasting, 100 cc. water......................	4	0.0	3.1	0.1	— 3.2	P_2O_5 in food, 0; in urine, 0.8 gm.; in feces, 0.1 gm.; loss, 0.9 gm.
2695	1888	.....do	Dog	15.6	1,000 gm. white of egg, 2.5 gm. disodium phosphate.	1	19.5	17.0	0.7	+ 1.8	P_2O_5 in food, 0.9 gm.; in urine, 0.9 gm.; in feces, 0; gain or loss, 0.
2696	1888	.....do	.....do	15.6	1,000 gm. white of egg, 12.5 gm. disodium phosphate.	2	20.4	20.2	0.7	— 0.5	P_2O_5 in food, 3.0 gm.; in urine, 3.0 gm.; in feces, 0; gain or loss, 0.
2697	1888	.....do	.....do	15.6	660 gm. white of egg, 250 gm. yolk of egg...	4	19.1	17.6	1.3	+ 0.2	P_2O_5 in food, 3.8 gm.; in urine, 3.0 gm.; in feces, 0.8 gm.; gain or loss, 0.
2698	1888	.....do	.....do	15.4	Fasting....................................	3	0.0	4.2	0.2	— 4.4	P_2O_5 in food, 0; in urine, 1.0 gm.; in feces, 0.1 gm.; loss, 1.1 gm.
2699	1888	Bergeat..........	Dog	22.0	.....do	3	0.0	6.9	0.0	— 6.9	P_2O_5 in urine, 1.5 gm.
2700	1888	.....do	.....do	....	700 gm. thymus	3	19.1	18.3	0.6	+ 0.2	P_2O_5 in food, 8.9 gm.; in urine, 7.7 gm.; in feces, 1.1 gm.; gain, 0.1 gm.
2701	1888	.....do	.....do	....	Fasting....................................	1	0.0	5.1	0.0	— 5.1	P_2O_5 in urine, 3.2 gm.
2701a	1888	.....do	.....do	....	800 gm. lungs	3	19.3	17.4	0.8	+ 1.1	P_2O_5 in food, 3.2 gm.; in urine, 2.8 gm.; in feces, 0.4 gm.; gain or loss, 0.
2701b	1888	.....do	.....do	....	Fasting....................................	2	0.0	13.0	0.0	—13.0	P_2O_5 in urine, 2.1 gm.
2702	1888	.....do	.....do	....	800 gm. liver	3	27.3	27.9	0.9	— 1.5	P_2O_5 in food, 7.4 gm.; in urine, 6.7 gm.; in feces, 0.6 gm.; gain, 0.1 gm.
2703	1888	Atwater..........	Dog	7.0	500 gm. fish, 15 gm. fat.....................	6	13.7	13.7	0.2	— 0.2	Nitrogen in urine determined 4 days.
2704	1888	.....do	.....do	7.0	375 gm. lean beef, 15 gm. fat................	6	13.0	12.9	0.3	— 0.2	Do.
2705	1893	Munk	Dog	11.4	130 gm. meat, 35 gm. fat, 90 gm. rice, 600 cc. water (34 gm. protein, 38 gm. fat, 70 gm. carbohydrates, 742 calories).	20	5.1	4.6	0.4	+ 0.1	
2706	1893	.....do	.....do	11.2	40 gm. meat, 37 gm. fat, 113 gm. rice, 600 cc. water (17 gm. protein, 38 gm. fat, 87 gm. carbohydrates, 742 calories).	5	2.6	2.2	0.5	— 0.1	
2707	1893	.....do	.....do	11.1	11 gm. meat meal, 53 gm. fat, 150 gm. rice, 600 cc. water (17 gm. protein, 55 gm. fat, 116 gm. carbohydrates, 1,070 calories).	23	2.7	2.2	0.5	0.0	
2708	1893	.....do	.....do	11.0	.....do	19	2.7	2.8	1.0	— 1.1	Nitrogen in feces determined 6 days.
2709	1893	.....do	.....do	11.0	.....do	5	2.7	2.8	(0.5)	— 0.6	First 5 days of No. 2708.
2710	1893	.....do	.....do	11.0	.....do	3	2.7	2.9	1.1	— 1.3	Sixth to eighth day of No. 2708.
2711	1893	.....do	.....do	11.0	.....do	3	2.7	2.5	1.0	— 0.8	Thirteenth to fifteenth day of No. 2708.
2712	1893	.....do	.....do	10.8	.....do	10	2.7	2.7	1.0	— 1.0	Nitrogen in feces determined 4 days.
2713	1893	.....do	.....do	10.8	46 gm. meat meal, 46 gm. fat, 119 gm. rice (40.4 gm. protein, 46 gm. fat, 93 gm. carbohydrates).	5	6.4	3.9	(1.0)	+ 1.5	
2714	1893	.....do	.....do	11.8	200 gm. meat, 45 gm. fat, 100 gm. rice, 500 cc. water (47 gm. protein, 50 gm. fat, 77 gm. carbohydrates, 942 calories).	11	7.6	4.7	0.5	+ 2.4	Nitrogen in feces determined 3 days.

TABLE 28.—*Experiments with dogs. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2715	1893	Munk	Dog	10.4	30 gm. meat meal, 29 gm. fat, 85 gm. rice, 600 cc. water (30.3 gm. protein, 31 gm. fat, 66 gm. carbohydrates, 663 calories).	17	4.8	3.8	0.5	+0.5	Nitrogen in the feces was determined on 4 days only.
2716	1893	....do	....do	10.1	....do	4	4.8	4.1	0.5	+0.2	Eleventh to fourteenth day of No. 2715.
2717	1893	....do	....do	10.0	10.4 gm. meat meal, 30 gm. fat, 105 gm. rice, 500 cc. water (15.3 gm. protein, 31 gm. fat, 81 gm. carbohydrates, 663 calories).	10	2.4	2.8	(0.5)	—0.9	
2718	1893	....do	....do	9.9	15.3 gm. protein. 32 gm. fat, 89 gm. carbohydrates, 794 calories.	15	2.5	2.4	0.5	—0.4	Nitrogen in the feces was determined on 3 days only.
2719	1893	....do	....do	9.8	....do	3	2.5	2.5	0.5	—0.5	Eighth to tenth day of No. 2715.
2720	1893	....do	Dog	9.9	15.5 gm. protein, 37 gm. fat, 96 gm. carbohydrates, 780 calories.	13	2.5	2.0	0.6	—0.1	Nitrogen in the feces was determined on 3 days only.
2721	1893	....do	....do	10.2	....do	3	2.5	1.9	0.6	0.0	Ninth to eleventh day of No. 2720.
2722	1893	....do	....do	10.2	....do	24	2.5	2.0	1.0	—0.5	Nitrogen in the feces was determined on 4 days only.
2723	1893	....do	....do	10.4	....do	4	2.5	2.1	1.0	—0.6	Sixteenth to nineteenth day of No. 2722.
2724	1893	....do	Dog	9.8	35 gm. meat, 44 gm. fat, 120 gm. rice (15 gm. protein, 45 gm. fat, 92 gm. carbohydrates, 833 calories).	17	2.4	2.5	(1.0)	—1.1	
2725	1893	....do	....do	9.6	30 gm. meat, 51 gm. fat, 140 gm. rice (15 gm. protein, 52 gm. fat, 107 gm. carbohydrates).	6	2.4	2.3	(1.0)	—0.9	
2726	1893	....do	....do	9.7	38 gm. meat, 51 gm. fat, 140 gm. rice (17 gm. protein, 52 gm. fat, 107 gm. carbohydrates).	8	2.7	2.2	0.5	0.0	Nitrogen in the feces was determined on 4 days only.
2727	1893	....do	....do	9.6	....do	21	2.7	2.2	0.6	—0.1	Do.
2728	1893	....do	....do	9.6	....do	8	2.7	2.3	0.8	—0.4	Nitrogen in the feces was determined on 3 days only.
2729	1893	....do	....do	9.5	....do	3	2.7	2.2	0.8	—0.3	Third to fifth day of No. 2725.
2730	1893	....do	....do	9.2	....do	16	2.7	2.5	1.0	—0.8	Nitrogen in the feces was determined on 3 days only.
2731	1893	....do	Dog	10.0	120 gm. meat, 30 gm. fat, 90 gm. rice (31.1 gm. protein, 32 gm. fat, 69 gm. carbohydrates, 700 calories).	7	4.9	4.3	0.4	+0.2	Nitrogen in the feces was determined on 4 days only.
2732	1893	....do	....do	9.4	36 gm. meat, 32 gm. fat. 110 gm. rice (14.5 gm. protein. 33 gm. fat, 85 gm. carbohydrates, 716 calories).	10	2.3	2.9	0.5	—1.1	Nitrogen in the feces was determined on 3 days only.

2733	1893	.....do	.....do	8.8	33 gm. meat, 45 gm. fat, 120 gm. rice (14.5 gm. protein, 45.5 gm. fat, 92 gm. carbohydrates, 852 calories).	12	2.3	2.5	0.5	—0.7	Do.
2734	1893	.....do	.....do	8.2	40 gm. meat, 45 gm. fat, 130 gm. rice (16.3 gm. protein).	9	2.6	2.2	(0.6)	—0.2	
2735	1893	.....do	.....do	8.4	.....do	5	2.6	2.1	0.6	—0.1	Last 5 days of No. 2734.
2736	1893	.....do	Dog	16.9	Fasting..	2	0.0	3.7	0.0	—3.7	Ninth and tenth days of fasting period.
2737	1894	Marcuse..........	Dog	6.3	100 gm. meat, 25 gm. lard, 30 gm. starch, 2 gm. meat extract, 50 cc. water.	12	3.7	4.3	0.2	—1.8	
2738	1894	.....do	.... do	6.0	27 gm. casein, 30 gm. lard, 30 gm. starch, 2 gm. meat extract, — gm. salts, 125 cc. water.	7	3.7	3.5	0.3	—0.1	Salts=a mixture approximating milk ash.
2739	1894	.....do	.....do	5.9	Same as No. 2737..............................	5	3.6	3.7	0.2	—0.3	
2740	1894	.....do	.....do	5.9	27 gm. casein, 26 gm. lard, 30 gm. starch, 2 gm. meat extract, 1.2 gm. sodium bicarbonate, 125 cc. water.	5	3.7	3.7	0.1	—0.1	
2741	1894	.....do	.....do	5.8	27 gm. casein, 26 gm. lard, 30 gm. starch, 1 gm. salts, 50 cc. water.	5	3.6	3.6	0.1	—0.1	Do.
2742	1894	.....do	.....do	5.8	100 gm. meat, 35 gm. lard, 30 gm. starch, 2 gm. meat extract, 1.2 gm. sodium bicarbonate, 50 cc. water.	8	3.6	3.4	0.2	0.0	
2743	1894	.....do	Dog	8.1	30 gm. casein, 9 gm. casein-calcium, 65 gm. bacon, 30 gm. starch, 16 gm. salts, 150 cc. water.	11	6.1	5.4	0.1	+0.6	Do.
2744	1894	.....do	.....do	8.3	23 gm. casein, 9 gm. casein-calcium, 100 gm. bacon, 1.2 gm. sodium bicarbonate, 10 gm. salts, 200 cc. water.	5	6.2	5.3	0.2	+0.7	Do.
2745	1895	Lange............	Dog	14.2	525.8 gm. milk................................	2	1.8	0.4		+1.4	Subject was 14 days old.

No. 2447. Ann. chem. Pharm., 88, p. 110. Nos. 2448, 2449. Virchow's Archiv, 10. p. 159. No. 2450. Physiologische chemischen Untersuchungen, 1857, p. 19. Nos. 2451, 2452. Ibid., pp. 21, 22. Nos. 2453, 2454. Ibid., pp. 23, 24. Nos. 2455–2514. Die Ernährung des Fleischfressers. Nos. 2515–2519. Ztschr. Biol., 2, p. 26. Nos. 2520, 2521. Ibid., p. 28. Nos. 2522, 2523. Ibid., p. 29. Nos. 2524, 2525. Ibid., p. 30. Nos. 2526, 2527. Ibid., p. 31. Nos. 2528, 2529. Ibid., p. 32. Nos. 2530–2533. Ibid., p. 33. Nos. 2534, 2535. Ibid., p. 34. Nos. 2536–2546. Ibid., p. 35. No. 2547. Ibid., p. 57. Nos. 2548–2550. Ibid., p. 58. Nos. 2551, 2552. Ibid., p. 59. No. 2553. Ibid., pp. 51, 59. No. 2554. Ibid., p. 52. Nos. 2555-2568. Ztschr. Biol., 3, pp. 310–321. Nos. 2569–2581. Ztschr. Biol., 5, p. 137. No. 2582. Ibid., p. 454. Nos. 2583, 2584. Ibid., pp. 456, 457. No. 2585. Ibid., p. 460. Nos. 2586, 2587. Ibid., pp. 462, 463. Nos. 2588, 2589. Ibid., pp. 465, 466. No. 2590. Ibid., p. 469. No. 2591. Ibid., p. 473. No. 2592. Studien über Stoffwechsel, p. 145. No. 2593. Ztschr. Biol., 9, p. 337, 376. Nos. 2594–2597. Ibid., p. 341, 377. Nos. 2598–2600. Ztschr. Biol., 10, p. 213. No. 2601. Pflüger's Arch. Physiol., 10, p. 548. Nos. 2602, 2603. Ztschr. Biol., 16, p. 405. Nos. 2604, 2605. Ibid., p. 392. Nos. 2606–2608. Ibid., p. 405. Nos. 2609, 2610. Ibid., p. 393. Nos. 2611–2613. Ibid., p. 406. Nos. 2614, 2615. Ibid., p. 395. Nos. 2616, 2617. Ztschr. Biol., 19, p. 566. Nos. 2618, 2619. Ibid., p. 567. No. 2620. Ztschr. Biol., 20, p. 382. Nos. 2621, 2622. The assimilation of the protein of milk and the metabolism of nitrogen on an absolute milk diet. Inaug. Diss. (Russian), St. Petersburg, 1885, p. 60. Nos. 2623–2626. Ibid., p. 61. Nos. 2627, 2628. Ibid., p. 62. Nos. 2629, 2630. Ibid., pp. 62, 63. Nos. 2631–2633. Ibid., p. 64. Nos. 2634, 2635. Ibid., p. 65. Nos. 2636–2643. Pflüger's Arch. Physiol., 37, p. 307. Nos. 2644–2657. Beiträge zur Kenntniss des Eiweissumsatzes im thierischen Organismus. Inaug. Diss. Leipsig, 1887, pp. 34, 35. No. 2658. Ztschr. Biol., 23, p. 437. No. 2659. Ibid., p. 441. Nos. 2660–2663. Phiziologicheskii Sbornik, Charkoff, 1, p. 56. No. 2664. Ibid., p. 65. No. 2665. Ibid., p. 67. Nos. 2666, 2667. Ibid., p. 74. Nos. 2668–2672. Ibid., p. 75. Nos. 2673–2675. Ibid., p. 80. Nos. 2676–2680. Ibid., p. 89. No. 2681. Ibid., p. 95. Nos. 2682–2686. Ibid., p. 98. Nos. 2687–2690. Ibid., p. 99. Nos. 2691, 2692. Ibid., p. 106. Nos. 2693, 2694. Ibid., p. 107. Nos. 2695, 2696. Ibid., p. 110. Nos. 2697, 2698. Ibid., p. 111. Nos. 2699, 2702. Ztschr. Biol., 24, p. 128, 133. Nos. 2703, 2704. Ztschr. Biol., 24, pp. 18–20. No. 2705. Virchow's Arch., 132, pp. 96, 97. No. 2706. Ibid., p. 98. No. 2707. Ibid., p. 103. Nos. 2708–2711. Ibid., pp. 104, 105. No. 2712. Ibid., pp. 109, 110. No. 2713. Ibid., p. 113. No. 2714. Ibid., pp. 114, 115. Nos. 2715, 2716. Ibid., p. 119. No. 2717. Ibid., p. 120. Nos. 2718, 2719. Ibid., p. 121. Nos. 2720, 2721. Ibid., p. 121. Nos. 2722, 2723. Ibid., p. 123. No. 2724. Ibid., p. 127. Nos. 2725, 2726. Ibid., p. 128. No. 2727. Ibid., p. 129. Nos. 2728, 2729. Ibid., p. 130. No. 2730. Ibid., p. 131. No. 2731. Ibid., p. 135. No. 2732. Ibid., p. 136. No. 2733. Ibid., p. 137. Nos. 2734, 2735. Ibid., p. 138. No. 2736. Ibid., p. 102. No. 2737. Pflüger's Arch. Physiol., 64, p. 245. Nos. 2738, 2739. Ibid., p. 246. Nos. 2740–2742. Ibid., p. 247. Nos. 2743, 2744. Ibid., p. 248. No. 2745. Jahrb. Kinderheilk., 39, p. 237.

No. 2447 was made by Bischoff in the laboratory of the Physiological Institute in Munich in 1853. The object was to investigate the influence of sodium chlorid on the excretion of urea. The subject was a dog. The food consisted of beef freed from bone and fat. Sodium chlorid in solution was given with the meat. The specific gravity, the urea, and the sodium chlorid in the urine were determined. The nitrogen in the food was calculated. In adding this experiment to the table the nitrogen in the feces was calculated by the compilers from Pettenkofer and Voit's experiments with a dog consuming the same quantity of food. The dog consumed during the whole time 158.82 grams sodium chlorid and excreted 145.0 grams in the urine. The feces were not examined, as they were not believed to contain any sodium chlorid. The author states that the results indicated a decomposition of sodium chlorid in the organism.

The nitrogen consumed was not all recovered. The weight of the animal was practically unchanged during the experiment. It was believed that no nitrogen was stored as flesh, but rather "that urea was retained and its transformation into other compounds, for instance ammonium carbonate, was hindered."

These experiments are interesting chiefly from an historical standpoint. They were published as a continuation of Bischoff's first publication on "Urea the measure of nitrogen metabolism."

Nos. 2448 and 2449 were made by Hoppe-Seyler in 1855. The object was to study the influence of cane sugar on digestion and nutrition. The subject was a dog. The food consisted of heart and lungs of sheep chopped fine and thoroughly mixed in a mortar. The experiment was divided into two periods. In one sugar was added to the normal diet. The nitrogen in the food and feces was determined by the Will-Warrentrapp method, and the fat in the food by extraction. The urea in the urine was determined by the Heintz method and the Liebig method. The attempt was made to determine the carbon dioxid in the respiratory products, but according to the author it was unsuccessful, and the results are not given by him. The dog appeared in normal condition throughout the experiment.

Among the conclusions reached were the following: No sugar was observed in the urine or feces when sugar was eaten for a long time, nor was the amount of lactic acid in the urine increased. When meat and sugar were eaten, the subject gained in weight more rapidly and excreted more urea than when meat alone was fed. The excretion of nitrogen in the feces was practically unchanged by the addition of sugar to the food. When much sugar is present in the blood, protein and allied substances are protected from oxidation. The reserve protein which is provided with little or no oxygen appears to be broken up, this process being accompanied by the formation of fat.

Nos. 2450–2454 were made by Voit in the laboratory of the Physiological Institute in Munich in 1856. The object was to investigate the metabolism of nitrogen. The subject of experiments Nos. 2450–2452 was a very active dog, and Nos. 2453 and 2454 a dog with a permanent gall fistula. The urea and nitrogen in several samples of urine, the dry matter and nitrogen in meat feces, and the dry matter and nitrogen in a number of samples of meat were determined. In experiments Nos. 2453 and 2454 the nitrogen in the gall obtained from the fistula was taken into account in determining the balance of income and outgo. Voit found that the mean nitrogen content of 6 samples of meat (fresh beef) was 3.5 per cent. He uses 3.4 per cent, however, in calculating the nitrogen in the meat consumed. He gives as a reason for the change the fact that the samples he analyzed were carefully selected samples of pure muscle. He believed, therefore, that the meat fed would have a slightly lower nitrogen content, since it would contain some fat, tendon, etc. This change has been much criticised by later observers in discussions of the formation of fat from protein.

The individual experiments are discussed in detail by the author. They are regarded as additional proof of the correctness of Bischoff's[1] opinion that the urea

[1] Der Harnstoff als Maass des Stoffwechsels, Giesen, 1853. See also a shorter account in Ann. Chem., 88 (1855), p. 101.

excreted in the urine may be regarded as a measure of the metabolized nitrogen, taking into account the small amounts in the uric acid and other compounds in the urine and feces, and in the epidermis and hair accidentally lost. These experiments are interesting to-day chiefly from an historical standpoint.

Nos. 2455–2514 and Nos. 2746–2750, Table 29, were made by Bischoff and Voit at the laboratory of the Physiological Institute, in Munich, in 1857–58. The object was to investigate metabolism of dogs while fasting, and on the following rations: (1) Meat; (2) meat and fat; (3) fat and starch with and without meat; (4) bread; (5) sugar with and without meat; (6) gelatin with and without meat, and (7) gelatin and fat.

The water was determined in bread with and without crust, in starch, grape sugar, and in the feces from each sort of diet. Nitrogen was determined in bread, gelatin, and in several instances in the feces. Carbon and hydrogen were determined in the feces from meat diet, bread diet, and starch diet. Fat was determined in meat, meat feces, meat and fat feces, and in gelatin and fat feces. Ash was determined in bread and in the feces from meat, bread, meat and starch, and from gelatin and fat. Sulphur was determined in meat, bread, gelatin, and the feces from meat, bread, and gelatin, and in many cases in the urine. In the urine from bread and from meat diet the dry matter and ash and their ratio to urea were determined also. The analyses were made with a few samples, and then the composition of food, urine, and feces was calculated from this data. The composition of the meat was calculated, and in very many cases that of the urine and feces also. It was assumed that the urine and feces from a particular diet were unvarying.

The points investigated are discussed at length, and the results obtained are compared with work of other observers.

The discussions are interesting from an historical standpoint, since much of the later work on metabolism is based on observations and conclusions from this series of experiments.

The principal conclusions reached were the following:

When fasting, a dog lives upon the flesh and fat of his own body and excretes urea, carbon dioxid, and water formed from them. The amount of fat and muscular tissue consumed is dependent upon the size of the animal. The conditions which affect the metabolism of nitrogenous material of the body are (1) the oxygen supplied, and (2) the size of the organs of the body, and (3) the amount of blood. Since it is the breaking down of nitrogenous tissue which furnishes energy, and energy is expended for internal muscular movement, all the changes in the animal body have a definite relation to each other.

To nourish a dog with meat only, so that flesh or fat is not lost from the organism, requires a considerable quantity of meat, varying from one-twentieth to one twenty-fifth of the weight of the dog. If less than this is supplied, tissue and fat from the organism will be metabolized. If more meat is supplied for one day than is necessary for nourishment, the excess is stored up. On the following day the same quantity of meat does not suffice to produce the same gain, but will all be utilized. A further gain of muscular tissue can be brought about only by a continued increase in the quantity of food consumed. When a maximum consumption is reached, the dog will not eat more, and loses weight rapidly. The quantity of meat which the dog needs to cover losses sustained and to gain flesh is always decided by the quantity of body tissue. If the dog has a large quantity of muscular tissue, he needs more food than when he has little flesh, and if he gains largely in muscular tissue he must consume an abundant diet of meat. The more fat meat consumed the less fat is used up from the body.

The metabolism of nitrogenous tissue and the elimination of nitrogenous material from the body is not prevented by consuming fat. The consumption of fat from the body can be prevented by consuming fat in the food. With an abundance of fat in the diet it is also possible to gain fatty tissue. The consumption of fat reduces the metabolism of nitrogen so that only one-third to one-fourth as much meat need be

consumed with fat as where meat only is fed. Sugar and starch act in the same way as fat. Bread is largely starch and can not furnish a complete diet for flesh-eating animals. Gelatin is of more importance than was supposed. It is apparently all changed into urea and seems to act as a protector of protein, not in the way that fat and starch do, namely, by diminishing the metabolism of this substance by lessening the consumption of oxygen, but directly in being substituted for nitrogenous substance of the body.

Nos. 2515–2554 were made by Voit in the laboratory of the Physiological Institute at Munich from 1859 to 1864. The older experiments (Nos. 2547–2554) are quoted by the author from previous publications which were not accessible to the compilers. A few seem to be either duplicates of or experiments reported in other publications. The object was to investigate the excretion of nitrogen by dogs.

The food usually consisted of meat, or meat and fat, sugar, or gelatin. In Nos. 2547 and 2548 coffee was given with the food, and in No. 2554 urea. The nitrogen and sometimes the ash in the food and feces were calculated. It would seem that the urea in the urine was determined and from this the nitrogen calculated.

The conclusion is reached that no nitrogen leaves the body except in the urine and feces. The concordance of the results for nitrogen and ash are looked upon as a proof of the accuracy of the conclusions drawn regarding nitrogen.

Nos. 2555–2568 were made by E. Bischoff at the laboratory of the Physiological Institute in Munich in 1867. The object was to investigate the excretion of phosphoric acid. The subject was a dog. The food usually consisted of meat, with fat or starch in some cases. Bread and starch were each fed alone, and in one experiment no food was consumed. The nitrogen and phosphoric acid in the meat were calculated. The factor for nitrogen was 3.4 per cent. The phosphoric acid in the starch and the nitrogen and phosphoric acid in the bread, the urea, and phosphoric acid in the urine, and the nitrogen, ash, and phosphoric acid in the feces were determined.

The principal conclusions drawn were the following: The excretion of phosphoric acid varies within wider limits than that of nitrogen. By increasing the metabolism of protein the excretion of phosphoric acid can be increased eight times the amount excreted when fasting. Phosphoric acid is excreted principally in the urine. In an animal in phosphorus equilibrium all the phosphoric acid consumed is excreted in the urine and feces.

If any considerable quantity of urine and feces had been lost there would have been a deficiency in the amount of excreted phosphorus. The fact that all the phosphorus consumed was recovered in the urine and feces is regarded as additional proof of the correctness of the theory that all the excreted nitrogen leaves the organism in the urine and feces.

Nos. 2569–2581 were made by Voit in the laboratory of the Physiological Institute in Munich in 1865 in connection with an extended study of the formation of fat in the animal organism. The subject was a female dog. The food consisted of meat, with starch or fat in a number of cases. The milk secreted by the dog was taken into account in determining the nitrogen balance. It is inferred that the nitrogen in the food and feces was calculated and the urea in the urine determined. It is not stated whether the water, casein, protein, fat, sugar, and ash in the milk were determined or calculated.

The following conclusions were reached: The secretion of milk is only slightly dependent upon the food (so far as composition of the milk solids is concerned). It decreased during fasting and was greatest on a diet rich in protein. The consumption of large quantities of fat with meat did not decrease the yield of milk as much as was reported by an earlier observer. The consumption of starch alone did not increase the yield of milk over that observed during fasting. The absolute and relative quantity of casein and protein in the milk was not directly proportional to the amount of protein in the food. It increased a little with a large consumption of meat and was lowered somewhat during fasting. The quantity of fat in the milk

was greatest when most protein was consumed and least when starch was consumed. The consumption of fat apparently exercised little influence on it. The amount of milk sugar showed very small variation, being greatest when much meat was consumed. The consumption of carbohydrates did not increase it. Other conclusions which have to do with the yield of milk, etc., are also drawn.

Nos. 2582–2591 were made by E. Bischoff at the laboratory of the Physiological Institute in Munich in 1867–68. The objects were (1) to ascertain whether other dogs would utilize a bread diet in the same way as the dogs in Bischoff and Voit's experiments (see Nos. 2471–2493); (2) to learn why bread is so poorly assimilated; and (3) to see if some simple addition could not be made to the diet which would render the bread more digestible. The food usually consisted of rye bread, with meat or meat extract in some cases. In one case salt was consumed. In No. 2590 the diet consisted of meat and starch. No. 2591 was made by Voit and reported by Bischoff. The nitrogen in the bread and nitrogen and water in the meat extract were determined. In the feces it was sometimes calculated and sometimes determined. The urea in the urine was determined.

The dog could not be maintained in good condition on a diet of rye bread. Sufficient nitrogen for the needs of the organism was not assimilated. On a diet of meat and starch, however, the dog gained strength and appeared in good condition. It was observed that the bread feces fermented very readily, and it was believed that the fermentation caused intestinal movements which hastened the excretion of the feces and thus hindered the intestinal absorption of nitrogenous material. The fermentation was studied at considerable length, but no reason for it was found. Neither meat extract nor salt exercised any marked influence on the absorption of the protein of bread in the intestine.

No. 2592 was made by Toldt at the University in Vienna in 1871. The object was to investigate the excretion of nitrogen. The subject was the same dog used in Seegen's experiments, Nos. 2770–2781, Table 29. The food consisted of meat. Great care was taken in collecting the urine. The urea in it was determined by the Liebig method and by the Schneider-Seegen method. The amount of nitrogen excreted in the feces was calculated. The nitrogen in the food was determined by the Dumas and by the soda-lime methods, and the conclusion was reached that the latter gave too low results. In the author's opinion all the consumed nitrogen was not recovered in the urine and feces or accounted for by a gain in weight of the subject.

Seegen quotes the author's results in the discussion of the gaseous excretion of nitrogen, and on the basis of the variations in the nitrogen content as shown by the analysis of meat, explains some of the discrepancies observed in previous investigations. He emphasizes the necessity of making analyses of meat by a reliable method.

Nos. 2593–2597 were made by Forster at the laboratory of the Physiological Institute at Munich in 1873. They form part of an extended investigation of the value of the mineral constituents of food. The subjects were 2 dogs, weighing about 26 and 32 kilograms at the beginning of the experiment. The food consisted of "meat residue," with fat, and some starch or sugar. In addition, on 1 day a little salt and on 4 days a little meat extract was consumed. "Meat residue" is meat from which the juices have been extracted by pressure and the salts have been removed by extracting three times with water. That used in these experiments was in the form of a coarse powder. The nitrogen and phosphoric acid in the food and urine, and the nitrogen, phosphoric acid, and ash (in Nos. 2593, 2594, and 2597 fat also) in the feces were determined. In all the experiments the iron in food and feces was determined. (Urine contains no iron.) The sodium chlorid and sulphuric acid in the urine in No. 2593, and the cyanuric acid, sodium chlorid, and the phosphoric acid combined with alkali and with earthy bases in Nos. 2595 and 2596 were also determined. In each experiment the dogs lost weight and were in poor condition. In No. 2597 it was evident that the dog could not have lived much longer on the diet. The conclusion was reached that certain salts are necessary for the animal organism, and that an animal will die if the amount supplied in the food falls below a definite quantity, or if none at all is supplied.

Many conclusions are drawn which can not be noted here, since they do not concern metabolism. The author reviews the literature of the subject at length.

Nos. 2598–2600 were made by Voit in the laboratory of the Physiological Institute at Munich in 1874. The object was to determine the nutritive value of ossein. The subject was a dog.

After a period of 4 days of fasting ossein and fat were fed. This diet was followed by a period of fasting. Ossein was prepared by treating bones with dilute hydrochloric acid.

The nitrogen, fat, ash, sulphuric acid, and phosphoric acid in the ossein, the nitrogen, urea, sulphur, sulphuric acid, and phosphoric acid in the urine, and the nitrogen, fat, ash, and sulphuric acid in the feces were determined.

The conclusion was reached that it was not possible to make a ration of ossein, fat, and mineral matters which would meet the needs of the organism.

The article contains an extended discussion of the "luxus consumption" theory and of the terms used in discussions on metabolism.

No. 2601 was made by Plósz and Gyergyai at Buda Pesth in 1875 in connection with a study of the food value of peptones. The subject was a dog, which was kept in a cage with glass sides and floor of wire netting. The urine and feces were collected together in a suitable vessel under the netting. The food consisted of peptones and a solution of starch, grape sugar, and melted butter. This was injected into the stomach. The peptone was prepared from dried fiber by digesting with the pepsin from a pig's stomach. The nitrogen in the food and excretory products was determined by Scegen's method.

The conclusion was reached that on a ration in which peptones are substituted for protein it is possible for the subject to gain in weight, and the gain may consist of nitrogenous tissue.

The article contains an extended review of the subject, with references to the work of other observers.

Nos. 2602–2615 were made by Gruber in the laboratory of the Physiological Institute at Munich in 1880. The objects were (1) to get light upon the question as to whether all the nitrogen consumed in the food could be recovered in the urine and feces; and (2) to test the accuracy of a number of experimental methods which had been employed by Voit.

As has been stated above, Voit held the opinion that no nitrogen was excreted except in the urine and feces. This was doubted by other investigators. The methods used by Voit in making his experiments had also been questioned. It was his usual plan to calculate the nitrogen in fresh meat, using as a factor 3.4 per cent. The nitrogen in the urine was ordinarily determined by the soda-lime method after evaporating with quartz sand. The nitrogen in the meat and feces was usually determined by the soda-lime method.

The subject of the present experiment was a dog weighing about 17 kilograms. The experiment lasted 22 days. The first 5 days were regarded as a preliminary period. The remaining days were divided into two periods of 7 and 10 days, respectively. The food was lean beef, which was prepared in quantity and kept on ice. The meat was freed from visible fat, tendon, connective tissue, etc., as much as possible, and ground several times in a sausage cutter. It was then pressed out in a large, flat cake on a porcelain slab, and portions were cut out here and there as samples for analysis. A comparative test was made to show that the samples obtained were representative. The water content of the meat was determined at the beginning of the experiment. The portions for each day's ration were weighed and put into an ice chest. As they were required the portions were again weighed. Any loss in weight was attributed to a loss of water, and sufficient water was added to make good the loss. Each day the dog was given 600 grams of meat thus prepared and 200 cubic centimeters of water. The day's ration was divided into two equal portions; one was fed at 8 a. m. and the other at 11 to 11.30 a. m.

The subject was confined in a cage, which stood in the middle of a large room.

The mean temperature of the room was 15° C. The dog was trained to deposit urine in a beaker glass. He was taken out of the cage three times a day for this purpose. The urine was measured and its specific gravity determined. The feces were separated by feeding bones, and collected and weighed. The nitrogen in the meat was determined by the Dumas (absolute) method and by the Will method, and the results obtained by the two methods were found to agree. The author also calculated the nitrogen in the meat, using the factor 3.554 per cent. This value was actually obtained as the mean of a number of determinations. The author believes that Voit's figure, 3.4 per cent, was equally correct as used in Voit's experiments, since the meat was then prepared in a somewhat different way. The nitrogen in the urine was determined by the Voit method; that is, the urine was evaporated at 100° C. with gypsum (instead of quartz sand) and oxalic acid, and the nitrogen then determined by the soda-lime method. The author found by experiment that practically no nitrogen was lost as ammonia during the evaporation of the urine. Parallel investigations have shown that practically the same results are obtained as when evaporated in a vacuum. The urea in the urine was determined by the Liebig method, and from this the nitrogen was calculated.

For purposes of comparison the nitrogen was also determined in a number of samples of the urine by the Dumas and the Schneider-Seegen methods. The Dumas method gave practically the same results as the Voit method. The Schneider-Seegen method gave slightly lower results. These figures are not included in the table.

The nitrogen in the feces was determined by the soda-lime method (Voit's) in samples of the feces for the whole experiment. It was assumed that the same amount of feces was excreted each day. In one period (No. 2609) the sulphur in the food, urine, and feces was also determined.

The principal conclusions reached were the following: Practically all the nitrogen consumed is excreted in the urine and feces. The differences observed were so small as to be within the limits of error. The view maintained by Voit concerning this question is therefore correct. The above conclusion is further strengthened from the fact that all the sulphur consumed was recovered in the urine and feces. In the case of sulphur there is no question of an excretion in the respiratory products. Since the same care was observed in determining the balance of income and outgo of nitrogen, it was believed that the results obtained were equally trustworthy.

Comparatively little difference was observed in the results when the different analytical methods were employed. The differences are less marked when the averages are taken, as in the table, than when the experiments are considered as a whole. In the preliminary period of 5 days the total nitrogen consumed, as determined by the Will method, was 106.6 grams. The total amount excreted in the urine and feces, using Liebig's method for urine, was 97.51 grams; using Voit's method, 99.40 grams. The total amount of nitrogen in the food in the 7-day period, as determined by the Dumas method, was 154.81 grams; as determined by the Will method, 154.14 grams; as calculated, using the factor mentioned above, 149.27 grams. During this period the total nitrogen excreted in the urine and feces, using Voit's method for urine, was 155.02 grams; using Liebig's method for urine, 150.82 grams. The total amount of nitrogen in the food in the 10-day period was 213.72 by the Dumas method and 213.06 by the Will method; as calculated, the amount was 213.24 grams. The total nitrogen in the urine and feces, using Voit's method for urine, was 213.26 grams; using Liebig's method, for the urine, it was 216.47 grams.

The total amount of meat consumed during the last 10 days of the experiment was 6,000 grams. On the basis of excreted nitrogen, the author calculated that 5,986 grams had been metabolized. On the basis of excreted sulphur the amount of meat metabolized was calculated to be 5,998 grams. The balance of income and outgo of water was also calculated. The article contains an extended review of the literature, particularly of the controversy regarding the excretion of nitrogen in the respiratory products, and of the accuracy of various analytical methods.

Nos. 2616–2619 were made by Gruber at the laboratory of the Physiological Insti-

tute at Munich in 1883. The object was to test the truth of the theory that all excretory nitrogen leaves the body in the urine and feces. The subject was a female dog. The food consisted of fresh meat and bacon, which was very carefully prepared in the way usual at the Munich laboratory. The urine was collected with a catheter. The nitrogen in the meat was determined by the Will-Warrentrapp method. In the bacon it was calculated from Hoffman's figures. The nitrogen in the urine and feces was determined. Careful records were kept of the dog's weight, correction being introduced for the feces produced.

The experiments are regarded as additional proof that all nitrogen is excreted in the urine and feces, since the difference between total consumed and excreted nitrogen in the experiments was very small. The dog's weight varied within small limits.

No. 2620 was made by Rieder at the laboratory of the Physiological Institute in Munich in 1884, and forms a series with Nos. 418–420, Table 7. The object was to investigate the amount of nitrogen in the feces which was due to undigested residue. The subject of this experiment was a dog. The food, which contained no nitrogen, consisted of starch and fat. The nitrogen in the urine and feces was determined. Other experiments, in which the nitrogen was determined in the feces but not in the urine, were made with the same subject, on a diet of starch and fat, a diet of meat, and while fasting. These could not be included in the present compilation.

When food free from nitrogen was consumed, more nitrogen was excreted in the feces than during hunger, and as much as when meat was consumed; that is, in every case the nitrogen of the feces was due to metabolic products, and the more work the intestine performed in digesting the food the greater the amount of such products.

Nos. 2621–2635 were made by Rudenko at St. Petersburg in 1885. The object was to study the assimilation of the nitrogenous constituents of milk, and the metabolism of nitrogen on an absolute milk diet. The experiments form a series with Nos. 54 to 78, Table 2. In the experiments with men and dogs the author experienced great difficulty in keeping subjects for any considerable time on an absolute milk diet. In the experiments with dogs, an absolute milk diet produced intestinal derangements and diarrhea. In order to avoid this, several articles were fed with the milk, and the best results were obtained when small quantities of cheese were used. The nitrogen of the milk consumed, and of the urine and feces, was determined by the Kjeldahl method, and the fat in the milk by the Soxhlet method. In several tests a mixture of salts which approximated the ash of casein was fed with the milk.

The principal conclusions reached were the following: The assimilation of the nitrogen of milk when fed alone was more complete than that of black bread, but less complete than that of milk and cheese. When bread and meat were fed, the feces contained about three times as much nitrogen as was the case when milk and meat were fed. More nitrogen was excreted in the feces on an absolute milk diet than on a meat diet. It was found possible to maintain dogs in nitrogen equilibrium on an absolute milk diet. In determining the quantity of milk necessary for this purpose, allowance must be made for the large amount of unassimilated nitrogen. When milk was fed in place of bread, there was a small gain of fat and the metabolism of nitrogen was intensified. More urine was excreted on an absolutely milk diet than on any other.

Nos. 2636–2643 were made by Pollitzer at the laboratory of the Physiological Institute of Bonn in 1885 (?). The object was to study the nutrition of a dog when peptones, albumoses, and gelatin were fed in place of meat. The dog was fed rice, starch (which was practically free from nitrogen), and fat, with a little salt. To these either meat or peptone, protoalbumose, heteroalbumose, or gelatin was added. The nitrogen in the food, urine, and feces was determined.

The conclusion was reached that when peptones were fed the gain in nitrogen was the same as when meat was eaten, while the gain of nitrogen on a diet containing albumoses was greater; that is, the nutritive value of peptone is about the same as that of meat, while that of albumose is greater. The dog lost in weight while con-

suming peptones. In the author's opinion this was probably due to the fact that peptones caused diarrhea.

Nos. 2644–2657 were made by Potthast at the laboratory of the Department of Animal Physiology of the Agricultural Institute at Berlin in 1886. The object was to determine the effect of the consumption of protein from different sources on the metabolism of protein in the animal organism. The subject was a dog. The food consisted of meat, meat meal, casein, lentils, wheat gluten, and lupines. The water, ash, fat, and fiber, and nitrogen in the food and feces and the nitrogen in the urine were determined. The crude fiber in the feces was calculated. The casein was prepared from milk. The lentils and gluten were ground before feeding. The bitter principle was removed from the lupines, and they were then hulled, dried, and ground. Each of these different articles was cooked in water with fat or starch, or both. In comparing the different foods, it was the author's intention to feed about the same amount of nitrogen and digestible nitrogen-free material in each period.

The following conclusions were reached: The experiments show that the nitrogen content of protein compounds is not a measure of their actual nutritive value. Thus the lupines contained the highest percentage of nitrogen, but had the least nutritive value. The protein of the meat, meat meal, casein, lentils, and gluten had about the same value.

Zuntz repeated some of Potthast's work with the same subject, and the author quotes the results in detail. The nitrogen in the food consumed, however, is not recorded. The test was divided into three periods. In the first period the ration consisted of 35 grams of the same meat meal used in the above experiment, 50 grams of starch, and 50 grams of fat. In the second period the ration consisted of 42 grams of lupine meal, 37.5 grams of starch, and 36 grams of fat. In the third period the ration was the same as in the first. The nitrogen excreted in the different periods in the urine, feces, and hair is shown in the following table:

The excretion of nitrogen on different diets.

Ration.	Nitrogen in—			Total nitrogen excreted.
	Urine.	Feces.	Hair.	
	Grams.	*Gram.*	*Gram.*	*Grams.*
Meat meal	3.99	0.43	0.09	4.52
Lupine meal	4.39	.41	.09	4.88
Meat meal	3.48	.43	.09	3.99

From these experiments the conclusion was drawn that the nitrogen of the meat meal ration was sufficient to maintain the dog in nitrogen equilibrium. When the same amount of nitrogen was fed in the lupine meal ration there was a daily loss of nitrogen equivalent to 17.3 grams of flesh.

The subject is discussed at length and extended reference is made to the work of other observers.

Nos. 2658, 2659 were made by Constantinidi in Munich, and form a series with Nos. 2 and 3, Table 1. The object was to investigate the digestibility of wheat gluten. The subject was a dog. The food consisted of wheat gluten and bacon. The water, nitrogen, fat, starch, cellulose, and ash in the gluten were determined, and in the bacon the water, connective tissue, nitrogen, and fat were calculated from Hoffman's figures. The urine was connected with a catheter. The nitrogen in it was determined by the Schneider-Seegen method. The nitrogen, ash, ether extract, alcohol extract, and water extract in the feces were determined. The gluten was very thoroughly assimilated, and in the author's opinion the small amount of nitrogen in the feces is not due to undigested residue, but to metabolic products.

Nos. 2660–2698 were made by Kolpakcha at the medical department of the University of Kharkov in 1887. The object was to learn the real source of the nitrogen

in the urine—that is, to determine whether it is derived directly from the protein consumed in the food, from protein stored in the tissue, or from actual protein tissue—and, further, to study the nature of stored protein. The experiments were made with dogs. The food consisted of meat, gelatin, white and yolk of eggs, fat, and starch, which were fed alone or in combination.

The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method, and the phosphoric acid by the volumetric method, using uranium nitrate. In some cases the sulphur, the alkali phosphates, and the alkali earth phosphates were determined.

The author endeavored to solve the problems under consideration by comparing the ratios of phosphoric acid to nitrogen and sulphur to nitrogen in the food consumed and in the urine. By repeated analyses it was found that these ratios in the foods were as follows:

In meat, $P_2O_5:N::1:7.3$; $S:N::1:15.6$.
In gelatin (no P_2O_5), $S:N::1:22.5$.
In whites of eggs, $P_2O_5:N::1:47.6$; $S:N::1:9.8$.
In yolks of eggs, $P_2O_5:N::1:1.8$.

The figures show that the protein in the different foods contains nitrogen, phosphoric acid, and sulphur in different proportions. The ratio of these elements in the urine was found to vary under different conditions of feeding and partial or complete fasting. Knowing the ratio of these elements in the food and in the urine and the ratio in the urine during partial or complete fasting, the author believed it was possible to judge whether the nitrogen in the urine came from the breaking down of the protein of the food consumed or from the breaking down of tissue protein.

The general plan of the experiments was to bring the subject into a condition of nitrogen equilibrium and then to either vary the character of the food (the amount of nitrogen remaining the same) or increase the amount of food. There were also periods of partial or complete fasting.

Eight experiments were made. Since they are the only ones of this nature found by the compilers, they will be described in detail.

The first experiment (Nos. 2660–2663) was of 16 days' duration and was divided into four periods. In the first period (No. 2660) the food consisted of 600 grams lean meat daily, the ratio of phosphoric acid to nitrogen being 1:7.3. Practically as much phosphoric acid and nitrogen were excreted in the urine as were consumed in the food, and the ratio was the same. Therefore the conclusion seems warranted that the phosphoric acid and nitrogen in the urine were derived from the breaking down of the protein compounds actually consumed in the food.

In the two following periods (Nos. 2661 and 2662) the dog was fed large quantities of meat, i. e., increased quantities of phosphoric acid and nitrogen. The amount of these elements excreted in the urine was also increased, but the ratio remained practically unchanged. This again indicates that the protein which was broken down to furnish the phosphoric acid and nitrogen in the urine was that consumed in the food. All the nitrogen consumed was not excreted, and therefore a part of the protein of the food was retained in the organism. The ratio of retained phosphoric acid to nitrogen was 1:9.5, or very nearly the same as the ratio in meat.

In the fourth period (No. 2663) the dog fasted. In the first days of fasting the ratio of phosphoric acid to nitrogen in the urine varied from 1:6.7 to 1:4.5. It then became almost constant (about 1:4). This would indicate that while fasting two kinds of protein are broken down, (1) "stored protein" (Vorrathseiweiss), i. e., protein which is retained in the body after excessive feeding and which has not yet had time to become a part of the actual body tissue; and (2) tissue protein, that is, protein which has actually become a part of the cell walls of the nitrogenous tissue of the body. The former is broken down with comparative ease, while the latter is more stable. From the ratio of phosphoric acid to nitrogen in the urine it would seem that the cleavage of tissue protein begins on the first day of

fasting. However, at first it is very largely stored protein which is broken down. As the stored protein is exhausted the organism approaches a condition when it must exist exclusively on its own tissues. If this condition is reached in the later days of fasting, then it may be assumed that the nitrogen and phosphoric acid in the urine are directly derived from protein of tissue and that the ratio of phosphoric acid to nitrogen in the urine (1:3.9 to 1:4.1) is the ratio of tissue protein also.

The protein assimilated from the food serves two purposes: (1) by being broken down it furnishes energy for carrying on the work of the organism, thus protecting protein of tissue; and (2) when excessive quantities of food are consumed the protein goes to form stored protein, which under favorable conditions may become organized protein, i. e., protein of tissue.

The second experiment (Nos. 2664 and 2665) lasted 14 days and was divided into two periods. After a preliminary period in which the dog was brought into nitrogen equilibrium it was fed excessive quantities of meat (No. 2664). The results obtained suggest that protein which is broken down in the organism and assimilated corresponds in chemical composition to the protein of the food. During the last period of this experiment (No. 2665) a ration consisting of fat and starch and containing no nitrogen was fed. As in the case of absolute fasting in the previous experiment the amount of nitrogen and phosphoric acid in the urine decreased on each succeeding day, but the ratio of one to the other was constant from the fifth day on. The ratio of these elements in the urine indicated in both cases (complete fasting and nitrogen-free food) whether stored protein or tissue protein or both were broken down, and also the quantity of each. The author believes that the increased amount of phosphoric acid in the urine in the last days of the fasting period is due to the fact that not only protein of nitrogenous tissue was broken down, but also protein from the bones. The bones are particularly rich in alkali earth phosphates, and during the period of fasting the proportion of alkali earth phosphates to alkali phosphates in the urine increased.

In order to study this point further, experiments were made in which the subject was fed white of egg, yolk of egg, and gelatin; i. e., protein compounds which contain nitrogen, phosphoric acid, and sulphur in different proportions from meat.

The third experiment (Nos. 2666–2672) lasted 18 days and was divided into three periods. In the first period (No. 2666) the subject was fed 500 grams meat and 200 grams lard daily until in a condition of equilibrium; that is, the outgo of nitrogen, phosphoric acid, and sulphur in the urine was equal to the amounts consumed. The ratio of these substances in the urine (P_2O_5 : N : : 1 : 6.9–7.1; S : N : : 1 : 15.1–16.8) was also about the same as in the meat.

During the following periods (Nos. 2667–2671) the dog received various quantities of white of egg with a little lard.

During the last period (No. 2672) the dog fasted. When passing from the meat ration to the white of egg ration the relative amount of phosphoric acid in the urine diminished, while the quantity of sulphur increased. A comparison of the ratios of phosphoric acid and sulphur to nitrogen in the food and urine indicates that the organism utilized some protein in addition to that in the food. The ratio of phosphoric acid to nitrogen in the urine during the period in which white of egg was consumed varied considerably. The relatively large amount of phosphoric acid in the first days of the period was due to the fact that some of it was derived from body tissue. The relatively small amount of phosphoric acid in the last days of the period must be accounted for on the basis of Förster's investigations, which show that when the organism is supplied with food poor in phosphoric acid it retains some of the phosphoric acid formed from the protein which is broken down. The other conclusions derived from this experiment in general agree with those previously stated.

The fourth experiment (Nos. 2673–2675) was practically a repetition of the preceding. The conclusions reached were as follows: The increased amount of nitrogen in the urine in the first period (No. 2673) indicated that the most favorable conditions for the breaking down of protein in the organism were (1) the consumption of excess-

ive amounts of protein and (2) the condition of the organism as to protein which exists after fasting. The amounts and ratio of nitrogen and sulphur in the urine indicated that during the first period only protein from the food was broken down. There was a decrease in the amount of nitrogen in the urine in the second period. While fasting, i. e., when the organism consumed its own tissue, the ratio of phosphoric acid to nitrogen was 1:3.9–4.1.

The fifth experiment (Nos. 2676–2680) lasted 13 days and was divided into three periods. It was undertaken chiefly for the sake of observing the influence of gelatin, which contains no phosphoric acid, on the breaking down of protein in the organism. In the first period (No. 2676) the ration consisted of meat and lard, in the second (Nos. 2677–2679) of gelatin and lard, while in the third (No. 2680) the subject fasted. In passing from the meat to the gelatin ration the quantity of nitrogen in the urine increased while the phosphoric acid decreased, though it did not entirely disappear. Consequently the consumption of gelatin alone can not prevent the breaking down of protein tissue; that is, the organism lives not only at the expense of the gelatin, but also at the expense of its own tissue. The increase in the amount of alkali earth phosphates, as compared with the alkali phosphates in the urine during the second period, indicated that not only when fasting, but also when the food consumed was insufficient, the nitrogenous tissue of the bones as well as the tissue protein was utilized.

The sixth (Nos. 2681–2690), seventh (Nos. 2691–2694), and eighth (Nos. 2695-2698) experiments were made to verify the results of the previous ones, and in general the conclusions drawn from them were the same.

From all his experiments the author draws the following conclusions: When food is consumed circulating protein and stored protein (which Voit calls *Circulerendes-eiweiss* and *Vorrtheiweiss*) appear to be identical in chemical composition with the protein of the food. When the food contains a sufficient amount of protein very little protein of tissue is broken down, since it is protected by the protein of the food. The tendency of the organism to break down only consumed protein is most noticeable under the following conditions: (1) When the income of protein in the food is excessive, (2) during nutrition after fasting, and (3) when the daily quantity of food is consumed at several different times. This theory also holds good in a comparison of the income and outgo of carbon, hydrogen, and oxygen. Thus the problem of nutrition comes to be the protection of the tissue from destruction, and not the destroying and rebuilding of tissue; and the nutrients consumed must serve for the production of the energy of the organism. Foods should be selected qualitatively and quantitatively according to their power to protect tissue. In experiments made to learn the nutritive value of a food material it is not sufficient to determine the nitrogen in the income and outgo. The phosphoric acid must also be determined as well as the ratio of phosphoric acid to nitrogen in the food and urine, since it is these factors which indicate whether tissue protein or other protein is being broken down. A knowledge of the relative amount of phosphoric acid in the tissue protein seems to be a very important and necessary factor in determining whether tissue or food protein is being broken down at any given time. Further, knowing the relative amount of phosphoric acid in the food, tissue protein, and urine, the quantity of each sort of protein which is broken down may be expressed mathematically. The author gives formulas for this purpose. When fasting the amount of tissue protein broken down as compared with stored protein is very small. The protein of the food and stored protein are broken down very readily, but the organism makes every attempt to protect tissue protein from consumption.

Nos. 2699–2702 were made by Bergeat at the laboratory of the Physiological Institute at Munich in 1885-86. The object was to determine the digestibility of thymus gland, lungs, and liver by a dog. These articles were fed to the subject after a period of fasting. A sufficient quantity of each was prepared for the whole experiment by removing all connective tissue, etc. The separation of the feces was made by feeding bones. The nitrogen, ash, phosphoric acid, ether extract, alcohol extract,

and water extract in food and feces were determined. The nitrogen in the urine was determined by the Schneider-Seegen method. The phosphoric acid and cyanuric acid were also determined.

The conclusion is reached that the digestibility of the foods under discussion did not differ materially from that of meat.

The author discusses the term "digestibility" at considerable length, and points out the difference between actual digestibility and ease of digestion.

Nos. 2703, 2704. See Nos. 195, 196, Table 2.

Nos. 2705–2736 were made by Munk at Berlin in 1890 and 1891. The object was to study metabolism on a diet which furnished an abundance of energy but contained little protein. The experiments were made with a view to determining the amount of protein which is actually essential for the animal organism. The subjects were dogs. The food consisted of meat, fat, and rice cooked together in water. The nitrogen in the food, urine, and feces was determined by the Kjeldahl method. The fat in the feces was also determined. In a few cases in which the nitrogen of the feces was not stated it was supplied by the compilers from other experiments in this series in which the food was the same. Four series of experiments were made. In every case, after a few days on a ration containing an abundance of protein, the dogs were fed a ration which furnished an abundance of energy but contained a small amount of protein. This was continued for 9 to 11 weeks, when a ration containing a large amount of protein was again supplied.

Although the ration containing insufficient protein was made up of meat, fat, and rice and was relished at first. after following it for a considerable time it became distasteful to the subjects. They could be induced to eat it only by feeding it in several portions, and eventually they refused it altogether. Even before the loss of appetite was noticed the subjects became weak. At first the ration was well digested, but gradually the assimilation became poorer, the decrease in assimilation of fat being greatest, of protein less, and of carbohydrates least. It was thought that the lack of assimilation was largely caused by a diminution in the secretion of the digestive juices.

The ration which was poor in protein but furnished an abundance of energy, when followed for a long time produced disturbances in the organism. The amount of disturbance was influenced by the individual characteristics of the subjects. The dogs recovered their normal condition very quickly when a ration containing an abundance of protein and little nitrogen-free material was again supplied. If, however, the subject is for any reason weak the ration poor in protein sometimes causes death when followed for a time.

From these experiments the author concludes that for a dog weighing 10 kilograms a ration furnishing 0.255 gram of nitrogen (equal to 1.6 grams of protein) and 100 or more calories per kilogram per body weight is not sufficient for the demands of the organism. A ration of the same fuel value must contain at least 0.31 gram of nitrogen (equal to 2.9 grams of protein) per kilogram body weight if the subject is to be maintained in nitrogen equilibrium and not lose weight.

For purposes of comparison the author quotes an experiment with a fasting dog (No. 2736) from his unpublished investigations.

The amount of protein actually required by man and animals is discussed at length and the results of other investigators are quoted.

Nos. 2737–2744 were made by Marcuse at the Physiological Institute of the University of Breslau in 1894. The object was to study the nutritive value of casein as compared with meat. The subjects were two dogs. Five tests were made, three of which were divided into two periods. In two cases a period with casein followed and in one case preceded a period with meat diet. Practically the same amount of nitrogen was consumed in each case. In the two remaining tests the diet consisted of casein and casein-calcium. Lard and starch were fed with the meat and casein, and meat extract was generally added to the food to make it more palatable. With the casein a mixture of salts, approximating milk ash, was also fed. Water was

consumed with the food, the amount being recorded. The urine was collected with a catheter. The feces was usually separated by feeding infusorial earth; sometimes, however, small porcelain beads in capsules were used.

The conclusion was reached that casein has the same nutritive value as the albuminoids of meat.

The author gives an extended review of previous investigations on this subject.

No. 2745 was made by Lange at the Medical Institute at the University of Leipsic in 1895, in connection with an investigation of the metabolism of nursing children on a diet of cows' milk. The subject was a dog 14 days old. The food consisted of milk sterilized with Soxhlet's apparatus. The urine and feces were collected together. The nitrogen in the food, urine, and feces was determined.

The conclusion was reached that in the case of young animals there is the same discrepancy between the amount of nitrogen retained in the body and the gain in weight as was observed in the case of children (see Nos. 116–125, Table 2).

Experiments were made by Zuntz[1] to study the nutritive value of meat peptones. By an oversight these were omitted from the tables. The subjects were two dogs weighing 3.1 and 5.2 kilograms, respectively. The first experiment was divided into five periods of five, six, five, four, and five days' duration. In the first, third, and fifth periods the food consisted of 120 grams of meat and 20 grams of fat; in the second period 48.5 grams of Kemmerich's meat peptone, and in the fourth period 60.7 grams of Koch's meat peptone were substituted for the meat.

The nitrogen in the food in the different periods was 3.9, 4.7, 3.9, 4.9, and 3.9 grams; in the urine, 3.4, 4.8, 3.3, 5.0, and 3.3 grams, and in the feces 0.3, 0.4, 0.4, 0.4, and 0.3 gram. In the first, third, and fifth periods there was a gain of 0.2, 0.2, and 0.3 gram, respectively, while in both the second and fourth periods there was a loss of 0.5 gram.

The second experiment was divided into three periods of one, ten, and four days, respectively. In the first period the food consisted of 70 grams of rice and 10 grams of fat; in the second period 40.4 to 60.6 grams of Kemmerich's meat peptone was taken in addition, and in the third period 75.8 grams of Koch's meat peptone.

The nitrogen in the food in the several periods was 0.7, 4.8, and 6.8 grams; in the urine 1.8, 4, and 6.1 grams, and in the feces, 0.1, 0.4, and 0.2 gram. In the first period there was a loss of 1.2 grams and in the second and third periods there was a gain of 0.4 and 0.5 gram, respectively.

The conclusion was reached that the two peptones had a high nutritive value, Kemmerich's being somewhat superior to Koch's in this respect.

INFLUENCE OF OTHER CONDITIONS THAN FEEDING.

In Table 29 are included 244 tests with dogs under various more or less abnormal or unusual conditions. In experiments Nos. 2746–2750 the subjects were fasting, in Nos. 2751–2955 the influence of various drugs was tested, in Nos. 2956–2962 the effect of baths was observed, and in Nos. 2963–2972 the influence of pregnancy and other phases of sexual life was studied. In all these experiments the dogs were in health. In Nos. 2973–2987 the dogs were suffering from the effects of a surgical operation.

An experiment with a dog on the influence of hot baths in which the balance of income and outgo of carbon was determined in addition to that of nitrogen will be found in Table 38.

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[1] Pflüger's Arch., 37 (1885), p. 313.

TABLE 29.—*Experiments with dogs. Influence of other conditions than feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2746	1860	Bischoff and Voit.	Dog	31.1	Fasting	6	0.0	9.4	0.0	— 9.4	
2747	1860	....do	Dog	32.2	....do	3	0.0	7.7	0.0	— 7.7	
2748	1860	....do	Dog	38.7	....do	7	0.0	8.6	0.0	— 8.6	
2749	1860	....do	Dog	29.0	....do	1	0.0	4.6	0.0	— 4.6	
2750	1860	....do	Dog	39.9	....do	1	0.0	2.7	0.0	— 2.7	
2751	1864	Seegen	Dog		500 gm. meat, 200 gm. fat	7	17.0	16.7	0.4	— 0.1	
2752	1864	....do	....do		500 gm. meat, 100 gm. fat	10	17.0	12.3	0.5	+ 4.2	Subject was given 1 gm. sodium sulphate.
2753	1864	....do	....do		....do	10	17.0	11.5	0.5	+ 5.0	Subject was given 2 gm. sodium sulphate.
2754	1864	....do	....do		....do	10	17.0	12.8	0.5	+ 3.7	Subject was given 3 gm. sodium sulphate.
2755	1864	....do	....do		....do	10	17.0	15.0	0.0	+ 2.0	Subject was given 4 gm. sodium sulphate.
2756	1864	....do	....do		....do	8	17.0	16.0	0.0	+ 1.0	Subject was given 2 gm sodium sulphate.
2757	1864	....do	....do		....do	30	17.0	14.7	0.4	+ 1.9	
2758	1864	....do	....do		....do	10	17.0	12.4	0.6	+ 4.0	Subject was given 1 gm. sodium sulphate.
2759	1864	....do	....do		....do	10	17.0	11.8	0.4	+ 4.8	Subject was given 2 gm. sodium sulphate.
2760	1864	....do	....do		....do	10	17.0	13.7	0.4	+ 2.9	Subject was given 3 gm. sodium sulphate.
2761	1864	....do	....do		....do	10	17.0	14.4	0.0	+ 2.6	
2762	1864	....do	....do		....do	10	17.0	14.3	0.2	+ 2.5	
2763	1865	Voit	Dog	32	1,500 gm. meat	4	51.0	50.2	0.6	+ 0.2	
2764	1865	....do	....do		....do	8	51.0	50.5	0.6	— 0.1	Do.
2765	1865	....do	....do		....do	5	51.0	51.1	0.6	— 0.7	
2766	1865	....do	....do		....do	6	51.0	50.5	0.6	— 0.1	Subject was given 4.5 gm. sodium sulphate.
2767	1865	....do	....do		500 gm. meat, 100 gm. fat	6	17.0	16.2	0.4	+ 0.4	
2768	1865	....do	....do		....do	8	17.0	16.3	0.4	+ 0.3	Subject was given 3 gm. sodium sulphate.
2769	1865	....do	....do		....do	4	17.0	16.2	0.4	+ 0.4	
2770	1867	Seegen	Dog		1,000 gm. meat, 100 gm. fat, 500 gm. water	20	34.0	20.0		+14.0	
2771	1867	....do	....do		....do	10	34.0	31.5		+ 2.5	Subject was given 1 gm. sodium bicarbonate.
2772	1867	....do	....do		....do	20	34.0	24.7		+ 9.3	Subject was given 2 gm. sodium bicarbonate.
2773	1867	....do	....do		....do	20	34.0	26.4		+ 7.6	

TABLE 29.—*Experiments with dogs. Influence of other conditions than feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2774	1867	Seegen	Dog		840 gm. meat, 1,300 gm. water	10	28.6	22.8		+5.8	
2775	1867	do	do		910 gm. meat, 1,300 gm. water	20	30.9	24.2		+6.7	
2776	1867	do	do		980 gm. meat, 1,300 gm. water	18	33.3	26.7		+6.6	Subject was given 1 gm. sodium bicarbonate.
2777	1867	do	do		do	10	33.3	29.4		+3.9	
2778	1867	do	do		do	10	33.3	30.0		+3.3	
2779	1867	do	do		1,100 gm. meat, 1,300 gm. water	10	37.4	35.4		+2.0	
2780	1867	do	do		do	10	37.4	38.2		—0.8	Do.
2781	1867	do	do		900 gm. meat, 1,300 gm. water	10	30.6	31.9		—1.3	
2782	1871	Von Boeck	Dog	25	500 gm. meat, 150 gm. fat, 150 cc. water	5	17.0	17.1	0.6	—0.7	
2783	1871	do	do		do	4	17.0	15.9	0.6	+0.5	Subject was given 0.1 gm. morphium acetate.
2784	1871	do	do		do	3	17.0	16.5	0.6	—0.1	
2785	1871	do	do		do	3	17.0	16.7	0.6	—0.3	
2785a	1871	do	do		do	5	17.0	14.5	0.6	+1.9	Subject was given 1 gm. quinin sulphate.
2786	1871	do	do		do	3	17.0	15 8	0.6	+0.6	
2787	1871	do	do		15 gm. meat	4	0.5	5.4	0.3	—5.2	
2788	1871	do	do		do	8	0.5	4.6	0.3	—4.4	Subject was given 0.03 gm. arsenic.
2789	1871	do	do		do	4	0.5	3.9	0.3	—3.7	
2790	1877	Munk	Dog	21.8	400 gm. meat, 50 gm. bacon, about 400 gm. water.	3	13.6	13.0	0.4	+0.2	
2791	1877	do	do	21.7	do	2	13.6	12.7	0.4	+0.5	Subject was given 25 gm. glycerin.
2792	1877	do	do	21.5	do	2	13.6	13.2	0.3	+0.1	
2793	1877	do	do	21.1	do	3	13.6	13.1	0.3	+0.2	
2794	1877	do	do	21.1	do	3	13.6	12.9	0.6	+0.1	Do.
2795	1877	do	do	21.0	do	1	13.6	12.6	0.4	+0.6	
2796	1877	do	do	21.1	do	3	13.6	12.2	0.4	+1.0	Subject was given 25 gm. sugar.
2797	1877	do	Dog	19.1	do	3	13.6	12.0	0.4	+1.2	
2798	1877	do	do	19.0	do	3	13.6	12.0	0.5	+1.1	Subject was given 30 gm. glycerin.
2799	1877	do	do	18.9	do	3	13.6	12.3	0.3	+1.0	
2800	1877	do	do	18.7	do	3	13.6	11.5	0.3	+1.8	Subject was given 30 gm. sugar.
2801	1877	do	do	18.7	do	3	13.6	12.3	0.4	+0.9	
2802	1877	do	do	18.6	do	3	13.6	12.2	0.5	+0.9	Subject was given 30 gm. glycerin.
2803	1877	do	do	18.5	do	3	13.6	12.2	0.4	+1.0	
2804	1878	do	Dog	25.1	800 gm. meat, 400 cc. water	4	27.2	27.7	0.4	—0.9	Subject was given 70 gm. fat.
2805	1878	do	do	24.8	do	3	27.2	27.6	0.5	—0.9	Subject was given fatty acids from 70 gm. fat.
2806	1878	do	do	24.5	do	3	27.2	27.2	0.4	—0.4	Subject was given 70 gm. fat.

2807	1878	.....do	.....do	24.4	.....do	3	27.2	28.0	0.4	—1.2	Subject was given fatty acids from 70 gm. fat.
2808	1878	.....do	.....do	24.3	.....do	2	27.2	28.4	0.4	—1.6	Subject was given 70 gm. fat.
2809	1878	.....do	Dog	31.0	600 gm. meat, 350–400 cc. water	5	20.4	20.1	0.4	—0.1	Subject was given 100 gm. fat.
2810	1878	.....do	.....do	30.5	.....do	21	20.4	19.5	0.2	+0.7	Subject was given fatty acids from 100 gm. fat.
2811	1878	.....do	.....do	30.8	.....do	5	20.4	21.2	0.4	—1.2	Subject was given 100 gm. fat.
2812	1881	Ott	Dog	10.0	500 gm. meat	10	16.8	16.0	0.3	+0.5	
2813	1881	.....do	.....do	....	.....do	7	16.7	15.8	0.3	+0.6	Subject was given 2 gm. sodium carbonate.
2814	1881	.....do	.....do	....	.....do	11	16.3	15.6	0.2	+0.5	
2815	1881	.....do	.....do	....	500 gm. meat, 150 gm. water	8	16.1	16.1	0.2	—0.2	
2816	1881	.....do	.....do	....	.....do	8	16.9	15.9	0.3	+0.7	Subject was given 5 to 10 gm. calcium carbonate.
2817	1881	.....do	.....do	....	500 gm. meat	6	17.0	16.5	0.3	+0.2	
2818	1881	Mayer	Dog (female)	22.0	500 gm. meat, 70 gm. bacon, 150 gm. water	1	17.1	16.0		+1.1	Subject was given 7 gm. sodium acetate.
2819	1881	.....do	.....do	....	.....do	3	17.1	16.5		+0.6	
2820	1881	.....do	.....do	....	.....do	4	17.1	16.5		+0.6	Do.
2821	1881	.....do	.....do	....	.....do	4	17.1	16.7		+0.4	
2822	1881	.....do	.....do	....	.....do	2	17.1	16.4	0.4	+0.3	
2823	1881	.....do	.....do	....	.....do	1	17.1	16.5	0.4	+0.2	Subject was given 7 gm. sodium magnesium carbonate.
2824	1881	.....do	.....do	....	.....do	3	17.1	16.6	0.4	+0.1	
2825	1881	.....do	.....do	....	.....do	4	17.1	18.1	0.4	—1.4	Subject was given 7 gm. sodium carbonate.
2826	1881	.....do	.....do	....	.....do	4	17.1	16.9	0.4	—0.2	
2827	1881	.....do	.....do	....	.....do	3	17.1	17.4	0.4	—0.7	Subject was given 3.5 gm. sodium carbonate.
2828	1881	.....do	.....do	....	.....do	3	17.1	16.6	0.4	+0.1	
2829	1881	.....do	.....do	....	.....do	4	17.1	16.6	0.4	+0.1	
2830	1881	.....do	.....do	....	.....do	5	17.1	16.0	0.4	+0.7	Subject was given 2.5 gm. sodium sulphate.
2831	1881	.....do	.....do	....	.....do	4	17.1	16.7	0.4	0.0	
2832	1881	.....do	.....do	....	.....do	5	17.1	15.6	0.4	+1.1	Subject was given 5 gm. sodium sulphate.
2833	1881	.....do	.....do	....	.....do	4	17.1	16.7	0.4	0.0	
2834	1881	.....do	.....do	....	.....do	4	17.1	16.7	0.4	0.0	
2835	1881	.....do	.....do	....	.....do	5	17.1	15.4	0.4	+1.3	Subject was given 7 gm. sodium phosphate.
2836	1881	.....do	.....do	....	.....do	4	17.1	16.3	0.4	+0.4	
2837	1881	.....do	.....do	....	.....do	5	17.1	16.2	0.4	+0.5	Subject was given 3.5 gm. sodium phosphate.
2838	1881	.....do	.....do	....	.....do	4	17.1	16.9	0.4	—0.2	
2839	1882	Albertoni	Dog	5.4	Fasting	3	0.0	[1.6] 1.5	(0.1)	—1.6	In Nos. 2839–2844 the values for nitrogen in urine inclosed in brackets were obtained by Seegen's method, the others by Hüfner's method.
2840	1882	.....do	.....do	4.9	220 gm. defibrinated dog blood, containing 35 gm. protein (=5.8 gm. nitrogen), was injected.	1	0.0	[2.3] 2.0	0.0	—2.0	

TABLE 29.—*Experiments with dogs. Influence of other conditions than feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2841	1882	Albertoni	Dog	4.9	Fasting	2	0.0	[1.9] 1.8	0.0	—1.8	Two days following No. 2840.
2842	1882	....do	Dog	7.8	....do	2	0.0	[1.9] 1.8	0.0	—1.8	
2843	1882	....do	....do	7.4	170 cc. defibrinated dog blood, containing 26 gm. protein (=5.2 gm. nitrogen), was injected.	1	0.0	[2.7] 2.5	0.0	—2.5	
2844	1882	....do	....do	7.4	Fasting	1	0.0	[2.7] 2.5	0.0	—2.5	Day following No. 2843.
2845	1882	Virchow	Dog	26	500 gm. meat, 75 gm. bacon, 200 gm. water	4	15.7	15.3	0.3	+0.1	
2846	1882	....do	....do		....do	6	17.0	14.3	0.3	+2.4	
2847	1882	....do	....do		....do	7	15.4	14.6	0.3	+0.5	
2848	1882	....do	....do		....do	8	17.3	14.5	0.3	+2.5	On 3 days subject was given 5-7 gm. benzoic acid.
2849	1882	....do	....do		....do	4	17.3	17.8	0.3	—0.8	Three days of No. 2848 on which benzoic acid was given, and next succeeding day.
2850	1882	....do	....do		....do	3	16.7	14.5	0.3	+1.9	
2851	1882	....do	....do		....do	3	15.4	14.9	0.3	+0.2	
2852	1882	....do	....do		....do	4	12.6	14.6	0.3	—2.3	On 3 days subject was given 7 gm. benzoic acid.
2853	1882	....do	Dog	22	....do	3	14.6	16.6	(0.3)	—2.3	
2854	1882	....do	....do	23	....do	2	16.4	18.0	(0.3)	—1.9	
2855	1882	....do	....do		....do	3	17.4	17.4	(0.3)	—0.3	On 2 days subject was given sodium salicylate.
2856	1882	....do	....do		....do	2	17.4	20.5	(0.3)	—3.4	Last day on which sodium salicylate was given, and next succeeding day.
2857	1883	Munk	Dog	35	1,000 gm. meat	7	34.0	33.8	0.5	—0.3	
2858	1883	....do	....do		....do	5	37.3	39.3	0.6	—2.6	On 3 days subject was given 25-30 gm. asparagin.
2859	1883	....do	....do		....do	3	34.0	33.6	0.5	—0.1	
2860	1886	Cheltsov	Dog		500 gm. meat	18	16.3	15.2	0.3	+0.8	
2861	1886	....do	....do		....do	24	16.3	16.5	0.3	—0.5	Subject was given 0.2 gm. ext. absinthii.
2862	1886	....do	....do		....do	6	16.3	16.0	0.4	—0.1	
2863	1886	....do	....do		....do	6	16.3	15.9	0.3	+0.1	
2864	1886	....do	....do		....do	18	16.3	15.8	0.3	+0.2	Subject was given 0.2 gm. ext. quassia.

2865	1886	do	do		do	6	16.3	15.9	0.3	+0.1	
2866	1886	do	do		do	3	16.3	16.3	0.3	—0.3	
2867	1886	do	do		do	15	16.3	16.0	0.4	—0.1	Subject was given 0.1 gm. ext. trifolii.
2868	1886	do	do		do	3	16.3	16.5	0.4	—0.6	
2869	1888	Chittenden and Blake.	Dog	12.6	50 gm. dried meat, 75 gm. crackers, 300 cc. water.	3	15.3	11.1	(0.4)	+3.8	
2870	1888	do	do		do	3	15.3	11.6	(0.4)	+3.3	
2871	1888	do	do		do	3	15.3	12.4	(0.4)	+2.5	
2872	1888	do	do		do	3	15.3	11.2	(0.4)	+3.7	
2873	1888	do	do		do	3	15.3	12.4	(0.4)	+2.5	Subject was given 1 grain antimonious oxid on 1 day.
2874	1888	do	do				15.3	11.7	(0.4)	+3.2	Average of Nos. 2869–2873.
2875	1888	do	do		50 gm. dried meat, 75 gm. crackers, 300 cc. water.	3	15.3	12.1	(0.4)	+2.8	Subject was given 1 grain antimonious oxid.
2876	1888	do	do		do	3	15.3	12.1	(0.4)	+2.8	Subject was given 1 to 1½ grains antimonious oxid.
2877	1888	do	do		do	3	15.3	12.4	(0.4)	+2.5	Do.
2878	1888	do	do		do	3	15.3	11.5	(0.4)	+3.4	Subject was given 1 grain antimonious oxid.
2879	1888	do	do				15.3	12.0	0.4	+2.9	Average of Nos. 2875–2878.
2880	1889	Spilker	Dog	15.9	450 gm. meat, 75 gm. fat, 200 cc. water	10	15.3	13.9	0.7	+0.7	
2881	1889	do	do	15.8	do	5	15.3	14.3	0.7	+1.3	Subject was given 15.4 gm. sodium acetate.
2882	1889	do	do	15.9	do	4	15.3	14.9	0.7	—0.3	
2883	1890	Taniguti	Dog (female)	15	450 gm. meat, 75 gm. lard, 200 cc. water	4	15.3	14.4	(0.4)	+0.5	Before chloroform was given.
2884	1890	do	do		do	1	15.3	14.1	(0.4)	+0.8	Subject was chloroformed.
2885	1890	do	do		do	4	15.3	15.6	(0.4)	—0.7	After chloroform was given.
2886	1890	do	do		do	4	15.3	14.7	(0.4)	+0.2	Before chloroform water was given.
2887	1890	do	do		do	1	15.3	14.7	(0.4)	+0.2	Subject was given 200 cc. chloroform water.
2888	1890	do	do		do	3	15.3	15.3	(0.4)	—0.4	After chloroform water.
2889	1890	do	do		do	3	15.3	14.4	(0.4)	+0.5	Before ether was given.
2890	1890	do	do		do	1	15.3	14.4	(0.4)	+0.5	Subject was etherized.
2891	1890	do	do		do	3	15.3	14.8	(0.4)	+0.1	After ether was given.
2892	1890	do	do		do	2	15.3	15.0	(0.4)	—0.1	Normal period.
2893	1890	do	do			26	15.3	14.7	(0.4)	+0.2	Average of Nos. 2883–2893.
2894	1890	do	Dog	30	500 gm. meat, 100 gm. lard, about 500 cc. water.	5	17.0	16.6	(0.4)	0.0	Before chloroform water was given.
2895	1890	do	do		do	1	17.0	16.7	(0.4)	—0.1	Subject was given 200 cc. chloroform water.
2896	1890	do	do		do	5	17.0	22.0	(0.4)	—5.4	After chloroform water was given.
2897	1890	do	do		do	4	17.0	12.8	(0.4)	+3.8	Normal period.
2898	1890	do	do		do	4	17.0	16.1	(0.4)	+0.5	Before paraldehyd was given.
2899	1890	do	do		do	7	17.0	18.1	(0.4)	—1.5	Subject was given 2–5 cc. paraldehyde first 4 days.
2900	1890	do	do		do	3	17.0	15.7	(0.4)	+0.9	Before chloral hydrate was given.
2901	1890	do	do		do	4	17.0	17.3	(0.4)	—0.7	Subject was given 2–5 gm. chloral hydrate.
2902	1890	do	do		do	3	17.0	15.9	(0.4)	+0.7	Normal period.
2903	1890	Mugdan	Dog	22.2	450 gm. meat, 100 gm. fat	2	15.3	15.6	0.4	—0.7	
2904	1890	do	do	20.0	do	8	15.3	15.5	0.4	—0.6	Subject was given 3 gm. creolin.
2905	1890	do	do	20.9	do	4	15.3	15.3	0.4	—0.4	

TABLE 29.—*Experiments with dogs. Influence of other conditions than feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		Days.	Gm.	Gm.	Gm.	Gm.	
2906	1890	Chittenden and Lambert.	Dog	18.8	40 gm. dried meat, 25 gm. crackers, 400 cc. water.	9	10.1	9.9	(0.4)	—0.2	On last day subject was given 0.05 gm. uranium nitrate.
2907	1890	do	do		do	9	10.1	10.0	(0.4)	—0.3	Subject was given 0.05–0.45 gm. uranium nitrate.
2908	1890	do	do		do	1	10.1	10.2	(0.4)	—0.5	
2909	1890	Chittenden and Dockendorff.	Dog	25.0	125 gm. dried meat, 60 gm. crackers, 600 cc. water.	21	(18.8)	16.4	(0.4)	+2.0	
2910	1890	do	do		do	17	(18.8)	16.1	(0.4)	+2.3	Subject was given 0.424–5.941 gm. paraldehyde.
2911	1890	do	do		do	6	(18.8)	15.9	(0.4)	+2.5	
2912	1890	Skvortsov	Dog	9.1	500 gm. meat	8	16.7	16.3	0.4	0.0	
2913	1890	do	do		do	7	16.5	16.2	0.3	0.0	Subject was given 0.03–0.07 gm. ferrum reducti.
2914	1890	do	do		do	5	16.5	15.9	0.3	+0.3	
2915	1890	do	do		do	9	16.3	15.9	0.4	0.0	Period before first bleeding.
2916	1890	do	do		do	4	16.1	15.5	0.3	+0.3	Period after first bleeding.
2917	1890	do	do		do	9	16.7	16.3	0.3	+0.1	Period after second bleeding. Subject was given 0.06–0.1 gm. ferrum reducti.
2918	1890	Fränkel	Dog	12	350 gm. meat, 45–70 gm. fat	7	(11.9)	9.2	0.7	+2.0	
2919	1890	do	do		350 gm. meat, 45 gm. fat	9	(11.9)	10.9	0.4	+0.6	Subject was given 0.1–0.5 gm. pyrodin.
2920	1891	Hahn	Dog (female)	22.5	500 gm. meat, 86 gm. fat, 560 cc. water	5	18.7	17.9	0.5	+0.3	
2921	1891	do	do	22.0	do	2	18.7	20.6	0.5	—2.4	Subject was given 2.5 gm. sulfonal.
2922	1891	do	do	21.8	500 gm. meat, 86 gm. fat, 560 cc. water (1 day 110 cc. water).	15	18.7	19.1	(0.6)	—1.0	
2923	1891	do	do	21.5	500 gm. meat, 86 gm. fat, 560 cc. water	1	18.7	17.8	(0.5)	+0.4	Do.
2924	1891	do	do	21.4	do	3	18.7	17.6	(0.6)	+0.5	
2925	1891	Norris and Smith (reported by Chittenden).	Dog	16.3	96 gm. beef (dried), 80 gm. crackers, 850 cc. water.	12	13.8	12.9	0.4	+0.5	
2926	1891	do	do	16.6	do	10	13.8	13.2	0.4	+0.2	Subject was given 29 cc. alcohol.
2927	1891	do	do	16.9	do	6	13.8	13.0	0.4	+0.4	
2928	1891	do	Dog	12.8	70 gm. beef (dried), 50 gm. crackers, 500 cc. water.	10	9.6	8.8	0.3	+0.5	
2929	1891	do	do	13.0	do	10	9.6	8.8	0.2	+0.6	Subject was given 29.9 cc. alcohol.
2930	1891	do	do	12.8	do	10	9.6	9.7	0.2	—0.3	
2931	1891	do	Dog	12.6	67 gm. beef (dried), 50 gm. crackers, 600 cc. water.	8	9.5	9.5	0.2	—0.2	

2932	1891	.....do	.....do	12.7	.....do	8	9.5	8.7	0.2	+0.6	Subject was given 35 cc. alcohol.
2933	1891	.....do	.....do	12.6	.....do	8	9.5	9.9	0.2	—0.6	
2934	1891	Dubelir	Dog	9.1	250 gm. meat, 50 gm. bacon	7	8.9	8.9	0.2	—0.2	
2935	1891	.....do	.....do		250 gm. meat, 50 gm. bacon, 300 cc. water (3 days).	7	8.9	8.7	0.2	0.0	
2936	1891	.....do	.....do		.....do	4	8.9	8.8		+0.1	Three days of No. 2935 with water.
2937	1891	.....do	.....do		.....do	3	8.9	8.6		+0.3	Four days of No. 2935 without water.
2938	1891	.....do	.....do		.....do	1	8.9	8.5	0.2	+0.2	Last day of No. 2935.
2939	1891	.....do	.....do		250 gm. meat, 50 gm. bacon, 550 cc. water (1 day).	7	9.1	8.7	0.2	+0.2	Subject was given 5.5 gm. salt on 4 days.
2940	1891	.....do	.....do		250 gm. meat, 50 gm. bacon	3	9.1	9.3		—0.2	Three days of No. 2939 without salt.
2941	1891	.....do	.....do		.....do	4	9.1	8.4		+0.7	Four days of No. 2939 with salt.
2942	1891	.....do	.....do		250 gm. meat, 50 gm. bacon, 550 cc. water (1 day).	8	8.9	8.3	0.2	+0.4	Subject was given 7.2 gm. salt on 5 days.
2943	1891	.....do	.....do		250 gm. meat, 50 gm. bacon	3	8.9	9.0		—0.1	Three days of No. 2942 without salt.
2944	1891	.....do	.....do		250 gm. meat, 50 gm. bacon, 550 cc. water (1 day).	5	8.9	8.2		+0.7	Five days of No. 2942 with salt.
2945	1891	Mauthner	Dog	20	500 gm. meat, 50 gm. bacon, 200 cc. water	6	16.6	17.7	0.3	—1.4	Days before asparagin period.
2946	1891	.....do	.....do		.....do	4	16.6	18.2	0.3	—1.9	Last 4 days of No. 2945.
2947	1891	.....do	.....do		.....do	3	20.4	21.1	0.3	—1.0	Subject was given 20 gm. asparagin.
2948	1891	.....do	.....do		500 gm. meat, 50 gm. bacon	1	16.6	19.0	0.3	—2.7	Day following No. 2947.
2949	1891	.....do	.....do		220 gm. starch, 9.8 gm. fat, 399.1 cc. water	5	0.3	3.8	0.4	—3.9	Five days before No. 2950.
2950	1891	.....do	.....do		220 gm. starch, 8.4 gm. fat, 413.7 cc. water	3	4.0	6.6	0.4	—3.0	Subject was given 20 gm. asparagin and 0.4 gm. potassium sulphate.
2951	1891	.....do	.....do		220 gm. starch, 5.7 gm. fat, 454.3 cc. water	3	0.3	3.2	0.4	—3.3	Three days following No. 2950.
2952	1891	.....do	.....do		220 gm. starch, 7.9 gm. fat, 426 cc. water	6	0.3	3.2	0.4	—3.3	Three days before and 3 days following No. 2950.
2953	1891	Brandt and Tappeiner.	Dog	12.8	Meat, soup, bread	110					First period subject was given 0.7 gm. sodium fluorid. Sodium fluorid in food, 0.7 gm.; in urine and feces, 0.4 gm.; gain, 0.3 gm.
2954	1891	.....do	.....do		.....do	307					Second period subject was given 0.5 gm. sodium fluorid. Sodium fluorid in food, 0.5 gm.; in urine and feces, 0.4 gm.; gain, 0.1 gm.
2955	1891	.....do	.....do		.....do	228					Third period subject was given 0.8 gm. sodium fluorid. Sodium fluorid in food, 0.8 gm.; in urine and feces, 0.7 gm.; gain, 0.1 gm.
2956	1886	Dommer	Dog	24	1,000 gm. meat, 100 gm. bacon, 200 cc. water	10	33.5	32.3	0.5	+0.7	
2957	1886	.....do	.....do	24	.....do	8	33.5	36.0	0.6	—3.1	Cold baths (10–12.5° C.).
2958	1886	.....do	.....do	24	.....do	5	33.5	32.3	0.6	+0.6	The nitrogen in feces was determined on 1 day only.
2959	1886	.....do	.....do	25	.....do	7	33.5	36.2	0.6	—3.3	Cold salt baths (12.5° C.). The nitrogen in the feces was determined on 6 days only.
2960	1886	.....do	.....do	25	.....do	4	33.5	32.6	(0.6)	+0.3	
2961	1886	.....do	.....do	25	.....do	9	33.5	32.2	0.6	+0.7	Warm baths (34° C.). The nitrogen in the feces was determined on 2 days only.

TABLE 29.—*Experiments with dogs. Influence of other conditions than feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss(—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
2962	1886	Dommer	Dog	26	1,000 gm. meat, 100 gm. bacon, 200 cc. water	7	33.5	36.0	0.6	—3.1	Warm salt baths (34° C.). The nitrogen in the feces was determined on 4 days only.
2963	1887	Potthast	Dog (female)	9.3	200 gm. meat, 20 gm. fat	8	6.7	6.6	0.2	—0.1	Last week of pregnancy. In Nos. 2963–2969 the nitrogen of the feces includes 0.1 gm. from hair.
2964	1887	....do	....do	6.9	300 gm. meat, 30 gm. fat, 30 gm. starch	9	10.2	8.9	0.7	+0.6	In full flow of milk. The young consumed milk only.
2965	1887	....do	....do	6.6	....do	3	9.4	8.5	0.7	+0.2	Do.
2966	1887	....do	....do	6.4	....do	3	9.4	7.7	0.7	+1.0	The young were given some food besides milk.
2967	1887	....do	....do	6.4	....do	9	9.4	7.3	0.7	+1.4	The young were taken from the mother.
2968	1887	....do	....do	6.8	200 gm. meat, 20 gm. fat, 55 gm. starch	3	6.7	4.7	0.8	+1.2	
2969	1887	....do	....do	6.9	....do	8	6.8	4.5	0.8	+1.5	Beginning of menstrual period.
2970	1888	Reprev	Dog (female)	5.1	676 gm. oatmeal (31 days)	21	2.3	1.5	0.8	0.0	Pregnancy. The nitrogen in the urine = the average of 32 days.
2971	1888	....do	....do	4.8	683 gm. oatmeal	1	4.6	3.9	0.6	+0.1	First day of No. 2970.
2972	1888	....do	....do	5.3	488 gm. oatmeal	2	1.6	1.4	0.6	—0.4	Last 2 days of No. 2970.
2973	1883	Vilizhanin	Dog	15.8	470 gm. meat, 200 gm. bread	3	19.9	18.1	1.4	+0.4	Normal period before operation.
2974	1883	....do	....do	....	550 gm. meat, 300 gm. bread	3	22.6	20.3	1.8	+0.5	Fistula of biliary bladder and ligature of ductus choledochi.
2975	1883	....do	....do	....	....do	33	22.7	21.6	1.5	+0.6	Jaundice period.
2976	1883	....do	Dog	87.6	480 gm. meat	7	16.3	15.4	0.6	+0.3	Normal period before operation.
2977	1883	....do	....do	68.0	472 gm. meat	46	16.0	17.0	0.5	—1.5	Jaundice period.
2978	1883	....do	Dog	89.3	300 gm. meat, —— gm. bread	6	11.9	10.9	0.6	+0.4	Normal period before operation.
2979	1883	....do	....do	72.0	....do	34	12.4	12.1	0.6	—0.3	Jaundice period.
2980	1887	Zouiev	Dog	13.2	350 gm. meat, 100 gm. bread. 175 gm. water	10	13.9	13.1	0.6	+0.2	Before ligature was made.
2981	1887	....do	....do	12.8	....do	9	14.3	13.7	0.6	0.0	After ligature was made.
2982	1887	....do	Dog	11.5	455 gm. meat, 100 gm. bread, 50 gm. water	10	17.2	16.4	0.6	+0.2	Before ligature was made.
2983	1887	....do	....do	11.3	....do	15	17.3	16.7	0.6	0.0	After ligature was made.
2984	1887	....do	Dog	9.1	282 gm. meat, 100 gm. bread, 150 gm. water	10	11.3	10.9	0.7	—0.3	Before ligature was made.
2985	1887	....do	....do	8.5	265 gm. meat (13 days), 94 gm. bread (13 days), 177 gm. water.	14	11.4	10.3	0.6	+0.5	After ligature was made. (Nitrogen in urine = average of 15 days).
2986	1887	....do	Dog	14.2	388 gm. meat, 100 gm. bread, 150 gm. water	10	15.1	14.5	0.6	0.0	Before control operation.
2987	1887	....do	....do	13.9	400 gm. meat, 100 gm. bread, 150 gm. water	10	15.6	15.2	0.5	—0.1	After control operation.
2988	1887	....do	Dog	12.9	....do	10	15.5	14.7	0.6	+0.2	Before control operation.
2989	1887	....do	....do	12.6	....do	10	15.6	14.9	0.6	+0.1	After control operation.

Nos. 2746–2750. Die Ernährung des Fleischfressers. Table. No. 2751. Studien über Stoffwechsel. p. 74. Nos. 2752–2762. Ibid., p. 73. Nos. 2763–2766. Ztschr. Biol., 1, p. 198. Nos. 2767–2769. Ibid., p. 200. Nos. 2770–2781. Jahresber. agr. Chem., 11, 12, p. 560. Nos. 2782–2786. Ztschr. Biol., 7, p. 420. Nos. 2787–2789. Ibid., p. 430. Nos. 2790–2794. Virchow's Arch., 76, p. 126. Nos. 2795–2803. Ibid., p. 127. Nos. 2804–2808. Virchow's Arch., 80, p. 17. Nos. 2809–2811. Ibid., p. 20. Nos. 2812–2814. Ztschr. Biol., 17, p. 169. Nos. 2815–2817. Ibid., p. 174. Nos. 2818–2838. Ztschr. klin. Med., 3, p. 82. Nos. 2839–2841. Jahresber. Thier. Chem., 12, p. 410. Nos. 2842–2844. Ibid., p. 411. Nos. 2845–2847. Ztschr. physiol. Chem., 6, pp. 84, 86. Nos. 2848–2853. Ibid., pp. 85, 86. Nos. 2853–2856. Ibid., pp. 89, 90. Nos. 2857–2859. Virchow's Arch., 94, p. 444. Nos. 2860, 2861. On the effect of bitter drugs on the digestion and assimilation of protein. Inaug. Diss. (Russian), St. Petersburg, 1886, p. 63. No. 2862. Ibid., p. 64. No. 2863. Ibid., p. 66. Nos. 2864, 2865. Ibid., pp. 66, 67. Nos. 2866–2868. Ibid., p. 69. Nos. 2869–2871. Trans. Connecticut Acad. Art and Sci., vol. 7, pt. 2, p. 296. Nos. 2872–2874. Ibid., p. 297. Nos. 2875, 2876. Ibid., p. 298. Nos. 2877–2879. Ibid., p. 299. Nos. 2880–2882. Ueber den Einfluss der Alkalien auf den Stoffwechsel, mit besonderer Berücksichtigung der Harnsäure. Inaug. Diss., Berlin, 1889, p. 29. Nos. 2883–2893. Virchow's Archiv., 120, p. 123. Nos. 2894–2902. Ibid., p. 128. Nos. 2903–2905. Ibid., p. 141. No. 2906. Trans. Connecticut Acad. Art and Sci., vol. 8, pt. 1, p. 3. Nos. 2907, 2908. Ibid., p. 4. No. 2909. Ibid., p. 45. No. 2910. Ibid., p. 46. No. 2911. Ibid., p. 47. Nos. 2912–2914. The influence of iron preparations on the animal organism. Inaug. Diss. (Russian), St. Petersburg, 1890, p. 50. Nos. 2915, 2916. Ibid., p. 57. No. 2917. Ibid., p. 58. Nos. 2918, 2919. Ztschr. klin. Med., 17, Sup., p. 247. Nos. 2920–2924. Virchow's Arch., 125, p. 185. Nos. 2925–2927. Jour. Physiol., 12, p. 224. Nos. 2928, 2929. Ibid., p. 227. No. 2930. Ibid., p. 228. No. 2931. Ibid., p. 229. Nos. 2932, 2933. Ibid., p. 230. No. 2934. Ztschr. Biol., 28, p. 238. Nos. 2935–2938. Ibid., p. 239. Nos. 2939–2941. Ibid., p. 241. Nos. 2942–2944. Ibid., p. 243. Nos. 2945–2948. Ibid., p. 509. Nos. 2949–2952. Ibid., p. 513. Nos. 2953–2955. Ibid., p. 526. No. 2956. Ztschr. klin. Med., 11, p. 516. Nos. 2957, 2958. Ibid., p. 517. Nos. 2959–2961. Ibid., p. 518. No. 2962. Ibid., p. 519. Nos. 2962–2969. Beiträge zur Kenntniss des Eiweiss umsatzes im thierischen Organismus. Inaug. Diss., Leipsic, 1887, p. 12. Nos. 2970–2972. On the influence of pregnancy on the metabolism of matter in animals. Inaug. Diss. (Russian), St. Petersburg, 1888, p. 86. Nos. 2973–2975. Metabolism of nitrogen in [animals affected with] jaundice. Inaug. Diss. (Russian), St. Petersburg, 1883, Table 1, p. 21. Nos. 2976, 2977. Ibid., Table 2, p. 36. Nos. 2978, 2979. Ibid., Table 3, p. 41. Nos. 2980, 2981. The influence of ligating the ductus thoracicus on the metabolism of nitrogen. Inaug. Diss. (Russian), St. Petersburg, 1889. Table 1, p. 25. Nos. 2982, 2983. Ibid., Table 2, p. 27. Nos. 2984, 2985. Ibid., Table 3, p. 29. Nos. 2986, 2987. Ibid., Table 4, p. 31. Nos. 2988, 2989. Ibid., Table 5, p. 33.

Nos. 2746–2750. See Nos. 2455–2514, Table 28.

Nos. 2751–2762 were made by Seegen in the laboratory of the Physiological Institute in Vienna in 1861–1863. The object was to investigate the influence of sodium sulphate on metabolism. The subject was a dog. Twelve tests were made, of from 7 to 30 days' duration. The food consisted of meat and fat. In 8 tests sodium sulphate was given. The nitrogen in the urine was at first determined by the Liebig titration method and later by the soda-lime method. The nitrogen in the meat used was calculated, using Voit's figure. The nitrogen in the feces was determined by the soda-lime method. The urine was usually collected directly, and any which was deposited in the cage in which the dog was confined was collected in a dish placed under an opening in the floor.

The following conclusions were drawn: When sodium sulphate was consumed, the assimilation of the food was not affected. The feces contained the same amount of nitrogen and nearly the same amount of fat as under normal conditions, but the water content was increased. The quantity of urine was normal, or a little less. Its nitrogen content was, however, much lowered. The gain in weight of the subject was not sufficient to account for the discrepancy between consumed and excreted nitrogen. The author believed that the metabolism of nitrogen-free tissue (fat) was considerably increased.

Nos. 2763–2769 were made by Voit at the laboratory of the Physiological Institute in Munich in 1864. The object was to determine the influence of sodium sulphate on nitrogen metabolism. The subject was a dog. The food consisted of meat, and in several cases fat also. The nitrogen in the food and feces was calculated and the urea in the urine determined. After the dog was in nitrogen equilibrium, sodium sulphate was given for a number of days. The conclusion was reached that the metabolism of protein was not at all affected by sodium sulphate. This is contrary to Seegen's opinion (see Nos. 2751–2762).

Nos. 2770–2781 were made by Seegen in the laboratory of the Physiological Institute in Vienna in 1866–67. The object was to study the influence of sodium carbonate on the metabolism of nitrogen. The subject was a dog. During the experiments he was confined in a cage. The floor was of zinc, and inclined so that any urine deposited in the cage could be collected in a dish placed underneath. The dog was trained to deposit urine in a dish, and in the later experiments this was always done. In the first experiments the floor of the cage was wiped up with a large dry sponge, which was weighed before and after use.

Twelve tests were made. In Nos. 2770–2773 the food consisted of meat and fat, and in Nos. 2774–2781 of meat only. Sodium carbonate was given in 4 tests. The nitrogen in the urine was determined by the soda-lime method; in the food it was calculated, using Voit's mean value for meat (3.4 per cent). Analyses of meat showed that this value was, however, a little low. The nitrogen in the feces was determined.

The conclusion was reached that under the influence of sodium carbonate the excretion of nitrogen through the kidneys was increased.

Nos. 2782–2789 were made by von Boeck at the laboratory of the Physiological Institute in Munich in 1871 with a dog. The object was to determine the influence of morphin, quinin, and arsenic-acid on the metabolism of protein. The food consisted of meat and fat. The nitrogen in the meat was calculated from Voit's figure. Morphin acetate, quinin sulphate, and arsenic-acid were each given for several days. Very little food was given with the arsenic, in order that there might be no vomiting. In every case a period with the drugs was preceded and followed by a period with normal diet. The urea in the urine was determined by the Liebig method. The nitrogen in the feces was also determined.

The following conclusions were reached: Morphin lowered the metabolism of protein a scarcely preceptible amount; quinin lowered it somewhat more than morphin; while arsenic, in the doses given, exercised no effect.

Nos. 2790–2803 were made by Munk in the chemical laboratory of the Pathological

Institute of the University of Berlin in 1877. The object was to study the physiological rôle of glycerin in the animal organism. The subjects were 2 female dogs. The food consisted of meat and bacon. The nitrogen in the meat was calculated from Voit's value. The nitrogen in the food and feces was determined by the Schneider-Seegen method. The feces were separated by feeding the animals pulverized cork. The author divides the tests into 4 series.

In the first series (Nos. 2790–2792) 25 grams of glycerin was fed in one period. This period was preceded and followed by a period with normal diet. The second series (Nos. 2793–2796) was divided into four periods. In the first the diet was normal; in the second 25 grams of glycerin was added; in the third period the diet was normal, and in the fourth period 25 grams of sugar was fed. In the third series (Nos. 2797–2800) the plan followed was the same as in the second, except that 30 grams of glycerin and 30 grams of sugar were fed. In the fourth series (Nos. 2801–2803) a period with 30 grams of glycerin was preceded and followed by a normal period.

The conclusion was reached that glycerin had no effect upon the breaking down of protein in the organism. In other words, it did not protect protein.

The literature of the subject is reviewed at length.

Nos. 2804–2811 were made by Munk in the physiological laboratory of the Veterinary Institute in Berlin in 1878 and 1879. The object was to study the value of fat and its constituents in metabolism, or, more definitely, (1) to compare the amount of fatty acids and their salts (soaps) in the feces, (2) to determine the digestibility of the fats and fatty acids and their salts in the chyle, and (3) to investigate the influence of fats and fatty acids upon the decomposition of protein in the organism. The subjects were 2 dogs, and the food consisted of meat. In the different periods a definite amount of fat or the fatty acids derived from the same quantity of fat were also fed. The feces were separated with pulverized cork. The nitrogen in the food was calculated from Voit's figure. The nitrogen in the urine and feces was determined by the Seegen method.

The following conclusions were reached: Fatty acids protect protein in the same way as the equivalent quantity of fat. When considerable quantities of fatty acids are fed, the amount excreted in the feces is very small. When fatty acids are consumed, only a very little more of their salts is excreted in the feces than when fat is consumed. When pure fatty acids are consumed, the fat content of the chyle is greatly increased and the chyle contains free fatty acids. The fatty acids are largely absorbed as an emulsion, and not as salts. The fatty acids are not only absorbed, but also undergo a synthesis to fats.

The literature of the subject is discussed at length.

Nos. 2812–2817 were made by Ott in the laboratory of the Physiological Institute in Munich in 1880. The object was to study the influence of sodium carbonate on the metabolism of nitrogen. The subject was a dog. His food consisted of meat with the connective tissue, etc., removed as much as possible. The dog had been fed 50 grams meat per day for a long time before the experiments were begun and was in nitrogen equilibrium. The experiment covered 50 days and was divided into six periods. During the second period 2 grams of sodium carbonate and during the fifth period 5 or 10 grams of sodium carbonate were given daily with the meat. The nitrogen of food, urine, and feces was determined. The urine and feces were collected directly.

The author concludes that sodium carbonate has no influence on nitrogen metabolism.

[The opinions regarding the influence of sodium carbonate on nitrogen metabolism are quite varied. Seegen[1] declared that it increased the amount of nitrogen in the urine. Rabuteau's[2] opinion was exactly the opposite.]

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[1] Studien über Stoffwechsel, p. 127.

[2] Gaz. hebd. Med. et Chir., 1871, No. 43, p. 692.

Nos. 2818–2838 were made by Mayer in 1881. The object was to investigate the influence of sodium acetate, carbonate, sulphate, and phosphate on the metabolism of nitrogen. The experiments were made with a female dog. The food consisted of meat prepared by Voit's method, and bacon. The nitrogen in the meat was calculated from Voit's figure and that in the bacon from Hoffman's figure (0.2 per cent). The urine was collected with a catheter and the bladder was washed out with water. The nitrogen in the urine, and probably in the feces, was determined by the Schneider-Seegen method. After a period of several days on the meat and fat diet one of the salts was given for a few days. This period was followed by several days on a normal diet.

The following conclusions were reached: Sodium acetate in large doses decreased the metabolism of protein a very little. Sodium carbonate increased the metabolism of protein in proportion to the dose, while sodium sulphate diminished it a very little, the amount being proportional to the dose. Small doses of sodium phosphate had no particular effect on the metabolism of protein; large doses diminished it somewhat. The excretion of urine was increased in every case.

Nos. 2839–2844 were made by Albertoni in 1882. The object was to study the effect of the transfusion of blood (1) upon the utilization of protein and (2) upon the excretion of carbon dioxid. The blood was defibrinated and injected into the peritoneal region. Experiments on the first question were made with dogs, and on the second with guinea pigs. So few data were recorded in some of the experiments with dogs that they could not be included in the present compilation, while in the experiments with guinea pigs no attempt was made to determine the balance of income and outgo.

The dog used in Nos. 2839–2841 was well nourished; that in Nos. 2842–2844 had been fasting a long time before the experiment and was weak. No food was given the dogs during the experiment. The nitrogen in the urine was determined by Seegen's and by Hufner's methods. Both values are included in the table. In only one case (No. 2839) were feces excreted. The nitrogen in the feces was supplied by the compilers from Kolpakcha's figures for a fasting dog (see experiment No. 2663, Table 28).

The conclusion is reached that when the subject was well nourished the transfusion of blood had no effect on the excretion of nitrogen, but when the subject was poorly nourished the excretion of nitrogen was somewhat increased.

Nos. 2845, 2856 were made by Carl Virchow at the laboratory of the Pathological Institute at Berlin in 1881. The object was to investigate the influence of sodium benzoate and sodium salicylate on the metabolism of protein. The subject was a female dog. The food consisted of chopped meat Sodium benzoate and sodium salicylate were given on several days. The urine was collected with a catheter. The nitrogen in the food, urine, and feces was determined by the Will-Warrentrapp method. The fat in the food, and the hippuric acid in the urine, on days when sodium benzoate was consumed, was also determined. In a few of the tests the nitrogen in the feces was supplied by the compilers from the previous tests reported by the author. After bringing the dog into nitrogen equilibrium she was twice fed sodium benzoate and once sodium salicylate for 3 days.

The following conclusions were reached: Sodium benzoate and sodium salicylate fed to the dog in nitrogen equilibrium caused a considerable increase in the breaking down of protein, as shown by the increased excretion of nitrogen. No after effect was noticed with the first drug, the second was injurious.

Nos. 2857–2859 were made by Munk in Berlin in 1883. The object was to investigate the influence of asparagin on protein metabolism and its value as a nutrient. The subject was a dog. Meat was the only food. On 3 days asparagin was given. The urine was collected with a catheter. The feces were separated by means of ground cork. The nitrogen in the meat was calculated, using the factor 3.4 per cent. The nitrogen in the urine was determined by the Schneider-Seegen method, and in the feces by the soda-lime method. In No. 2857 (without asparagin) the total sul-

phuric acid in the urine was determined and in No. 2858 (with asparagin) the total sulphur.

The author reports a second experiment with a dog in which the feces were not analyzed. The test covered 17 days. The food consisted of 700 grams meat, 120 grams starch, and 200 cubic centimeters of water per day. On the ninth, tenth, and eleventh days 25 to 30 grams of asparagin were given in addition. During the 8 days before and the 6 days after the asparagin period the average daily consumption of nitrogen was 23.8 grams and during the asparagin period 29.1 grams. The excretion of nitrogen in the urine in the corresponding periods was 26.2, 27.4, and 31.6 grams. The conclusion was reached that in the case of a dog in practically nitrogen equilibrium asparagin did not protect protein, but rather the cleavage of protein was increased a little.

Nos. 2860–2868 were made by Cheltsov in St. Petersburg in 1886. The object was to investigate the effect of bitter drugs on the digestion and assimilation of protein. They form a series with experiments Nos. 2011–2019, Table 19. The subject was a dog. The food consisted of meat. On several days either ext. absinthii, quassia, or ext. trifolii were given in the food.

The conclusion was reached that bitter drugs, even in small doses, disturb the digestion and assimilation of protein.

Nos. 2869–2879 were made by Chittenden and Blake at the laboratory of physiological chemistry at Yale University in 1886. The object was to investigate the influence of antimonious oxid on metabolism. The subject was a dog. The animal was confined in a suitable cage, so that the excreta could be collected. The food consisted of beef and crackers. The beef was prepared by freeing it from fat, tendon, etc., grinding it fine, and drying it until it had lost about 75 per cent of its water. Sufficient meat and crackers were prepared for the whole experiment. The nitrogen in the meat and in the urine was determined by the Kjeldahl method; that in the feces was supplied by the compilers from experiments in which the food was similar. The reaction, specific gravity, phosphorus, sulphur, and chlorin in the urine were also determined. After a number of days on normal diet antimonious oxid was given in small doses.

The conclusion was reached that small repeated doses of antimonious oxid had no influence on the excretion of nitrogen, sulphur, and phosphorus; that is, this compound when taken in nontoxic doses has no effect on metabolism of protein.

Nos. 2880–2882 were made by Spilker at the Medical Institute of the University of Berlin in 1889. The object was to study the influence of sodium acetate on metabolism, with special reference to the excretion of uric acid. The subject was a dog. The food consisted of meat and fat. A period during which sodium acetate was added to the food was preceded and followed by a normal diet. The urea in the urine was determined by the Salkowski method and the nitrogen by the Kjeldahl method. The composition of the food and feces was computed by the author, using Voit's mean value, 3.4 per cent for meat.

The author also made experiments in which he himself was the subject, but the food consumed and the amount and composition of the feces are not recorded.

The following conclusions were reached: Large doses of sodium acetate diminished the uric-acid excretion in man and increased that of a dog already in nitrogen equilibrium. In both cases the specific gravity of the urine was increased. In the case of the dog there was a marked increase in the excretion of urine.

Nos. 2883–2902 were made by Taniguti at the laboratory of the Pathological Institute of the University of Berlin in 1889. The object was to investigate the influence of chloroform, chloroform water, ether, paraldehyde, and chloral hydrate on the breaking down of protein in the animal organism. The subjects were dogs and the food consisted of meat. The periods in which the drugs were given were preceded and followed by periods with normal diet.

From his own experiments the author draws the conclusion that the breaking down of protein is increased by the drugs used, and that if the action of chloroform is a

specific one, the other narcotic materials have a similar action, which is least noticeable when they are taken for several days in succession.

Nos. 2903–2905 were made by Mugdan in Berlin in 1888 to study the poisonous effects of creolin and its influence on metabolism. The subject was a dog. The food consisted of meat and fat. On a number of days creolin was given. The nitrogen content of the food was calculated and the nitrogen in the urine and feces was determined. The sulphur compounds in the urine were also determined and tests for indican were made.

The conclusion was reached that creolin in the doses given did not influence the cleavage of protein. After taking creolin only traces of carbolic acid and indican were found in the urine. The absence of the latter indicates a diminution in intestinal putrefaction. Creolin caused an increase in the sulphuric acid and neutral sulphur in the urine, but a decrease in total sulphur. Tests were also made by the author with a dog and a rabbit to study the effect of creolin on the number of bacteria in the feces.

Nos. 2906–2908 were made by Chittenden and Lambert at the laboratory of physiological chemistry at Yale University in 1885, to study the physiological and toxic effect of uranium salts. The subject, a female dog, was kept in a cage suitably arranged for collecting the excreta, and was fed soda crackers and lean beef chopped fine and dried until it had lost about 75 per cent of the water content. The nitrogen in the food and urine was determined by the Kjeldahl method; that in the feces was supplied by the compilers from experiments in which the food was similar. The specific gravity, reaction, sulphur, and phosphorus in the urine were also determined. A normal period preceded the period in which uranium nitrate was given in varying doses.

The conclusion was reached that uranium salts had a marked influence on the excretion of urine, the increase amounting, on the average, to 80 cubic centimeters per day. The specific gravity of the urine was also increased. On a number of days the sugar and albumen in the urine were determined. The urine showed traces of albumen soon after uranium nitrate was taken, and in about 5 days sugar appeared.

Experiments on the toxic action of uranium were made with rabbits. The experiments were, however, not of the kind included in the present compilation.

Nos. 2909–2911 were made by Chittenden and Dockendorff at the laboratory of physiological chemistry at Yale University in 1886. The object was to investigate the influence of paraldehyd on the metabolism of protein. The subject was a dog. The experimental methods were the same as those noted above. The paraldehyde produced no noticeable hypnotic effect, and the conclusion was reached that it has little, if any, action upon metabolism of protein.

Nos. 2912–2917 were made by Skvortsov in St. Petersburg in 1890. The objects were to study (1) the influence of a preparation of iron on the metabolism and assimilation of nitrogen of healthy animals, and (2) its effect when introduced into the gastro-intestinal canal on the rapidity with which hæmoglobin is restored to the blood after artificially induced anæmia. The same dog was used in the study of both questions. The food consisted of horse meat, and in two cases ferum reducti was given in addition. The nitrogen in the food, urine, and feces was determined by the Kjeldahl method, with Pflüger's and Boland's modifications. The urea in the urine was determined by Liebig's method.

In Nos. 2912–2914 the first question was studied. The dog was fed until the condition of nitrogen equilibrium was reached. He was then given iron (ferum reducti). This period was followed by a period under normal conditions.

In Nos. 2915–2917 the second question was investigated. During the interval between Nos. 2915 and 2916 artificial anæmia was induced by bleeding the dog from the veins in the neck. The wounds were allowed to remain open and were washed with a solution of boric acid. The amount of hæmoglobin in the blood was determined for two days before and after bleeding. The dog was bled a second time fourteen days later in the interval between Nos. 2916 and 2917. After the second bleeding the subject was given ferum reducti on several days and the metabolism of

nitrogen and the amount of hæmoglobin in the blood were determined. Sixteen days after the second bleeding the dog was bled a third time and the hæmoglobin content of the blood was again determined. The nitrogen balance was, however, not reported by the author.

From these experiments and others not of the kind included in the present compilation the following conclusions were reached: The medicinal preparation of iron given with the food apparently did not perceptibly change the metabolism of nitrogen, but seemed to intensify the breaking down of carbohydrates and fats; when taken after artificially induced anæmia it undoubtedly caused a rapid restoration of the hæmoglobin content of the blood.

Nos. 2918, 2919 were made by Fränkel at the laboratory at the Agricultural Institute at Berlin in 1890. The object was to investigate the influence of pyrodin (acetyl-phenyl hydrazin) poisoning on metabolism. The subject was a dog. The food consisted of meat. A sufficient amount of meat was prepared for the whole experiment, and sterilized by heating at 100° C. The separation of the feces was made with bones. The author does not calculate the amount of nitrogen in the food consumed, but in a discussion of the amount of nitrogen in the portion of the food which was vomited by the dog assumes that the nitrogen content of the meat was 3.4 per cent. This value was used by the compilers in supplying the figures in the table. The nitrogen in the urine and feces was determined. Pyrodin was dissolved in warm water and given in subcutaneous injections. Very soon after taking the pyrodin the urine became dark reddish brown in color. When the dose was increased, the urine contained blood and albumen. The dog appeared in normal health until the dose was increased to 0.5 gram. It then showed symptoms of poisoning, and died on the following day. The blood and organs were carefully examined.

The conclusion was reached that small doses (0.1 gram) of pyrodin increased the excretion of nitrogen in the urine immediately and that this increase was caused by the poisonous effect of the drug on the different tissues of the organism. Large doses increased still further the nitrogen excretion.

The author reviews the literature of the subject at length.

Nos. 2920–2924 were made by Hahn at the chemical laboratory of the Pathological Institute of the University of Berlin in 1891. The object was to investigate the influence of sulfonal upon the metabolism of protein. The subject was a female dog. The food consisted of meat, fat, and water. The urine was collected with a catheter. The nitrogen in the food was calculated from Voit's figure, 3.4 per cent. The nitrogen in the urine and feces was determined by the Kjeldahl method. On 2 consecutive days and later on 1 day sulfonal was given with the food.

In the author's opinion it was possible to draw no conclusion from this experiment regarding the influence of sulfonal upon the metabolism of protein.

Nos. 2925–2933 were made by Norris and Smith at the laboratory of physiological chemistry at Yale University in 1893, and reported by Chittenden. The object was to study the influence of alcohol upon the metabolism of protein. The subjects were 3 dogs. The food consisted of beef and milk crackers. The meat was freed from fat and tendon, passed through a chopping machine, and dried at 45–50° C. It was then ground to a coarse powder and kept in jars. The milk crackers were also ground to a coarse powder.

The nitrogen in the meat and crackers and the urine and feces was determined by the Kjeldahl method. The sulphur and phosphorus, the specific gravity, and the reaction of the urine were also determined. Each experiment was divided into three periods. During the second period alcohol was added to the daily ration.

The conclusion was reached that alcohol had no striking specific action on the general metabolism of protein. The investigators believe that alcohol acts as a nonnitrogenous food and tends to protect protein slightly. The excretion of uric acid was increased in the alcohol period. This indicates, in the authors' opinion, that alcohol has some specific effect upon nutrition.

Nos. 2934–2944 were made by Dubelir at the Physiological Institute in Munich in 1881. The object was to investigate the influence of water and of salt upon the

excretion of nitrogen. The subject was a dog. The food consisted of meat and bacon. The feces were separated by means of bones. The nitrogen in the food, urine, and feces was determined by the Will-Warrentrapp and Schneider-Seegen methods. A normal period preceded and followed the period during which water or salt was added to the diet. The experiments were not begun until the dog was in nitrogen equilibrium. In No. 2936 the water was introduced into the stomach with a stomach tube.

The conclusion was reached that in these experiments drinking water had very little or no effect on the excretion of nitrogen, and that salt diminished the excretion of nitrogen a little, while the amount of urine excreted was nearly doubled.

Nos. 2945–2952 were made by Mauthner at the Physiological Institute in Munich in 1882. The object was to study the influence of asparagin on the metabolism of protein in Carnivora. The subject was a female dog. The plan was to feed asparagin (1) with a diet containing an abundance of protein, and (2) with a diet containing fat and carbohydrates but no protein. The food in Nos. 2945–2948 consisted of meat and bacon, and in Nos. 2949–2952 of starch and fat. In each case asparagin was fed for 3 days. In No. 2950 potassium sulphate was fed also. A period with asparagin was preceded and followed by a normal period. The urine was collected with a catheter. The feces were separated by means of bones. The nitrogen in food (including asparagin), urine, and feces was determined by the Will-Warrentrapp method. The sulphur and phosphoric acid in the urine were determined in nearly every case.

The author does not draw definite conclusions from his experiments, but thinks that if asparagin exercises any influence on the metabolism of protein it must be very slight.

Another experiment was made in which a young dog weighing 8.7 kilograms was fed starch, gelatin, fat, asparagin (4.48 grams nitrogen daily), potassium phosphate, water, and meat extract. In 15 days the dog lost 580 grams in weight, although an abundance of nitrogen was consumed in the food. When 130 grams meat daily (24 grams protein) was substituted for the asparagin, the dog gained 620 grams in weight in 8 days. The urine and feces were not analyzed. From this experiment the conclusion is drawn that asparagin can not take the place of protein.

Nos. 2953–2955 were made by Brandt and Tappeiner at the Physiological Institute in Munich in 1890–91. The object was to study the storing up of fluorin compounds in the organism when sodium fluorid was fed. The subject was a young but full-grown dog. The food consisted of cooked meat, the soup made from it, and bread. Sodium fluorid solution was poured over the meat; after it had been absorbed the meat could be fed without trouble. When the dry salt was mixed with the meat, the dog could with difficulty be made to eat it, and sometimes vomiting was produced. From 0.1 to 0.9 gram pure sodium fluorid was fed daily. The fluorin in the urine and feces was determined. The experiment lasted from February 7, 1890, to November 16, 1891. In discussing the experiments the author divides the time into three periods. In the first a total of 27.8 grams sodium fluorid was stored up in the organism; in the second period 21.2 grams, and in the third period 23.4 grams, making a total of 72.6 grams. At the close of the experiment the dog was killed and the various organs, etc., weighed and analyzed. The blood, liver, kidneys, and muscular tissue did not differ much from the normal condition. The bones were, however, unusually white, very hard, and found to be full of small crystals, presumably calcium fluorid. The experiment is discussed in detail.

The conclusion is reached that when the food contains soluble fluorin compounds large amounts will be stored up in the organism. The larger part will be found in the bones.

Nos. 2956–2962 were made by Dommer at the Pharmacological Institute of the University of Königsburg in 1883. The object was to study the effect of different baths on the metabolism of protein in the animal organism. The subject was a dog. The food consisted of horse meat, bacon, and water. The connective tissue, etc., was

removed, as far as possible, from the meat. The nitrogen in the meat was determined from Stohmann's value for horse meat, 3.35 per cent. The nitrogen in the urine was determined by the Schneider-Seegen method, and the nitrogen in the feces was calculated.

The experiment was divided into seven periods. In the first, third, and fifth periods the dog was fed until a condition of nitrogen equilibrium was reached. In the second period he was given a cold bath (10°–12.5° C.); in the fourth period a cold salt bath (12.5° C.); in the sixth period a warm bath (34° C.), and in the seventh period a warm salt bath (34° C.). The baths were of a half hour's duration in every case. The salt baths were prepared by adding sufficient coarse salt to make a 4 per cent solution.

The following conclusions were reached: The cold fresh and salt baths caused an increased excretion of nitrogen in the urine. The after effect could not be determined. Though they did not increase the body temperature, the warm salt baths increased the cleavage of protein in the organism perceptibly, but not as much as the cold baths. The warm fresh-water baths exerted no influence on metabolism.

Nos. 2963–2969 were made by Potthast at the laboratory of animal physiology of the Agricultural Institute of Berlin in 1886. The object was to study the effect of different phases of sexual life on the metabolism of protein. The subject was a female dog.

The experiment was divided into seven periods. The first covered the last days of pregnancy. Eleven days elapsed between the first and second periods. On the day following the first period the subject gave birth to 6 young. Two were taken away and 1 died; the others nursed during the second and third periods. The subject was in full flow of milk during the time. During the fourth period the puppies were given some food in addition to the mother's milk. They were taken from the mother at the end of the period. During the fifth period the subject was in a condition of sexual rest. On the last day of the sixth period she came in heat, and remained in this condition during several days of the seventh period.

The food consisted of meat and fat in the first period, and meat, fat, and starch in the other periods. The meat was chopped, mixed, and sterilized by heating in an air bath at 70° C. It was prepared in large portions. The nitrogen in the meat, urine, feces, and in the hair lost was determined.

The following conclusions were reached: The cleavage of protein in the organism is greater during pregnancy than after the period of lactation has ceased. During the period of lactation the cleavage of protein in the organism is greater than during the period of sexual rest.

Rabuteau's[1] opinion that during the menstrual period the metabolism of protein is lowered was not corroborated by this experiment. The author made extended reference to the work of other investigators on the subject.

Nos. 2970–2972 and Nos. 3272–3287, Table 34, were made by Reprev in St. Petersburg in 1878. The object was to investigate the influence of pregnancy on the metabolism of matter in animals. The subjects of the experiment were a female dog and two rabbits. One of the rabbits became pregnant three times, the other once. Other experiments with dogs and rabbits were undertaken, but were not successful. The author also reports experiments with a rabbit and a guinea pig, in which the respiratory quotient was determined. These latter are not of the kind included in the present compilation.

The experiment with a dog covers the last days of pregnancy. Three of the experiments with rabbits included periods of sexual rest as well as pregnancy. The nitrogen of the food, urine, and feces was determined by the Kjeldahl-Borodin method. The urea, chlorids, and phosphates of the urine were estimated. The respiratory quotient was determined by Pashutin's[2] method. The author does not regard the experiment with a dog as satisfactory, since the subject ate up her young. How-

[1] Gaz. hebd. de Paris, 1870, July.

[2] Vrach, 7 (1886), No. 18.

ever, the conclusion was reached that, during pregnancy, the cleavage processes were diminished, while the processes of assimilation were intensified.

From the investigation as a whole the following general conclusions were drawn: During pregnancy the organism absorbs more from the food and rejects less than during periods of sexual rest. The metabolism of nitrogen decreases, and less is excreted in the urine. Nitrogen is stored up in the body. In other words, the processes of assimilation are intensified, while those of excretion are diminished. Less urea and phosphates are excreted during pregnancy than under normal conditions. The amount diminishes as pregnancy advances. During pregnancy less oxygen is exhaled and less carbon dioxid excreted than under normal conditions; that is, the oxidation processes are weakened.

Hagemann[1] made experiments with two female dogs to study the influence of the various phases of sexual life on the metabolism of protein. In the report of the experiments the data were not given in such form that they could be included in the tables in the present compilation. The experiment with one of the subjects was not successfully completed. The other subject weighed 12.5 kilograms, and during sexual rest, while in heat, during pregnancy, lactation, and sexual rest following the period of lactation, the diet remained the same. It consisted of 300 grams of meat, 50 grams of fat, and 60 grams of starch daily, which furnished 9.986 grams nitrogen. The inference is that food, urine, and feces were analyzed. At the beginning of the experiment, during sexual rest, there was a daily gain of 0.187 gram nitrogen. Just before coming in heat this amount increased to 0.570 gram daily. While in heat the excretory products were not analyzed. In the eight days immediately following, there was a daily loss of 0.376 gram nitrogen, and during the first three weeks of pregnancy the daily loss was 0.177 gram. During the last half of this period, however, there was a daily gain of 0.220 gram, and during the eighteen days immediately before delivery the daily gain increased to 1.617 grams. The dog gave birth to two young weighing 740 grams. They were nursed until they weighed 3,250 grams. During this period the daily excretion of nitrogen in the urine and feces was 1.498 grams less than the amount consumed. During the period of sexual rest, immediately after the young were weaned, the dog gained only 1.297 grams of nitrogen daily. In another experiment, made during a period of sexual rest, the dog was fed 200 grams of rice, 17 grams of meat meal, and 60 grams of fat daily. This furnished 4.36 grams of nitrogen. After a time, nitrogen equilibrium was reached and maintained on this diet. The conclusion was reached that menstruation increased the metabolism of nitrogen, and that during pregnancy and the period of lactation nitrogen was retained to supply the unusual demands of the organism.

Nos. 2973–2979 were made by Vilizhanin in St. Petersburg in 1883. The object was to study the metabolism of nitrogen when the functions of the liver were disturbed. Three experiments were made with dogs. Jaundice was induced as follows: In Nos. 2974 and 2977, the *ductus choledochi* was ligated and a fistula of the biliary bladder was also made. Both dogs licked up the bile which was discharged, so that nearly all of it got back into the organism. During sleep, however, it was collected into a vessel placed under the cage. The fistula could be closed at will and jaundice would follow.

In No. 2979 a part of the *ductus choledochi* was cut out without forming a fistula of the biliary bladder, and the abdominal wound sewed up.

The first experiment was divided into three periods, (1) before operation (normal), (2) with biliary fistula, (3) with jaundice. The other two experiments were divided into two periods, (1) before operation (normal) and (2) with jaundice. The nitrogen of the food was determined by the Will-Warrentrap method, that of the urine by the Seegen method in the first experiment, and in the other by the Will-Warrentrap method. The nitrogen of the feces was also determined, presumably by the Will-Warrentrap method.

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[1] Virchow's Arch., 121 (1890), p. 557.

The author draws the conclusion that the passage of bile into the blood caused an intensified cleavage of protein in the organism, as a result of which an increased outgo of nitrogen in the urine was observed.

Nos. 2980–2989 were made by Zouiev in St. Petersburg in 1887. The object was to investigate the influence of ligating the *ductus thoracicus* on the metabolism of nitrogen in dogs. The author attempted 15 experiments, but was unable to complete them all. The dogs experimented upon were kept for a considerable time in cages, until nitrogen equilibrium was reached. The operation was then performed. The *ductus thoracicus* was ligated at the neck. An incision was made through the skin 4 to 6 centimeters long. The cutaneous wound was sewed up. The operation was performed under narcosis. The wound never healed *per primam*, and there was always some suppuration.

The food consisted of horse meat and bread. The nitrogen of the food, feces, and urine was determined in the first experiment by the Kjeldahl method, and in the others by the Kjeldahl-Wilfarth method. Each experiment was divided into two periods, (1) before and (2) after the operation. In the first three experiments the *ductus thoracicus* was ligated. The dogs recovered from the operation in a short time and were then killed. On dissecting, the ligature of the *ductus thoracicus* was found to be closed. A solution of prussian blue injected into the *ductus thoracicus* did not pass into the veins. In the last two experiments, which were made as a control, the *ductus thoracicus* was operated upon, but was not ligated. The dogs recovered completely and were then killed. On dissecting, everything was found normal.

The following conclusions were reached: In every case when the *ductus thoracicus* was ligated immediately after the operation a decrease in the outgo of nitrogen was observed. During the next 4 or 5 days the outgo increased and gradually became normal. The metabolism of nitrogen increased after the operation, whether the *ductus thoracicus* was ligated or not.

A number of tests were made by Aronsohn and Sachs[1] in connection with a study of the relation of the brain to body temperature and to fever. Experiments were made with rabbits and a dog to ascertain the effect on metabolism of injuring the brain by puncturing it with a needle, either through the eye or through an opening made in the skull. This caused an increased body temperature. Four tests were made with a dog. In the fourth morphin was given when the operation was performed. In each test the daily food consisted of 70 grams of rice, 10 grams of fat, and a little salt. According to Zuntz[2] this would contain 0.7 gram of nitrogen. In the first three tests before the operation was performed the dog excreted in the urine on an average 1.8 grams of nitrogen per day, and in the fourth test 2.0 grams. During the fever the dog excreted in the urine in the second, third, and fourth tests on an average 2.3, 1.5, and 2.7 grams. After the temperature again became normal, in the second test the daily excretion of nitrogen in the urine was 1.7, and in the third test 2.1 grams.

These tests and those with rabbits, mentioned on page 365, in the author's opinion, show that the abnormally high temperature resulting from the operation performed on the brain caused an increased cleavage of protein, as is the case in fever due to other causes.

EXPERIMENTS WITH DOVES AND POULTRY.

INFLUENCE OF FEEDING.

In Table 30 are included 1 test with chickens, 1 with a dove, and 6 with geese. The special questions investigated are noted in the text of the individual experiments.

[1] Pflüger's Arch., 37 (1885), p. 232.
[2] Ibid., p. 313.

TABLE 30.—*Experiments with doves and poultry. Influence of feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (−).	
				Kg.		*Days.*	*Gm.*	*Gm.*		*Gm.*	
2990	1845	Sacc	Cock and hen (average).	0.7	33.4 gm. barley, 7.6 gm. sand, 0.6 gm. chalk	7	0.8	0.3		+0.5	Ash (including sand and chalk) in food 9.2 gm., in excreta 8.7 gm., gain 0.5 gm.
2991	1862-63	Voit	Dove		25.3 gm. peas	124	1.2	1.2		0.0	
2992	1878	Weiske and Mehlis	Goose I		1,000 gm. dandelion leaves	3	2.8	2.4		+0.4	
2993	1878	do	Goose II		do	3	2.8	2.6		+0.2	
2994	1878	do	Goose I		1,500 gm. dandelion leaves	3	5.3	4.1		+1.2	
2995	1878	do	Goose II		do	3	5.3	4.1		+1.2	
2996	1878	do	Goose I		1,000 gm. horse-tail rushes	3	3.3	3.0		+0.3	
2997	1878	do	Goose II		do	3	3.5	3.1		+0.4	

No. 2990. Expériences sur les partics constituantes de la nourriture qui se fixent dans le corps des animaux, p. 7. Neue Denkschrift allgemeine schweiz. Gesell. gesammt. Naturwiss., 7. No. 2991. Ann. Chem., Sup. II, p. 240. Nos. 2992-2997. Landw. Vers. Stat., 21, p. 415.

No. 2990 was made by Sacc at Giessen in 1843 to determine what percentage of the food was retained by the animal body. The experiment was made with a cock and a hen. The average figures for one chicken are given in the table. The food consisted of barley. Sand and chalk were also fed. The elementary composition of the food and feces was determined. The respiratory products were not taken into account. The chickens in this experiment on a ration of barley excreted in the feces a little less than half the substance which they consumed. The feces consisted of one-fourth of the organic material and practically all of the inorganic material consumed. The latter probably resisted the mechanical action of the digestive tract and the digestive juices, and it was doubtless excreted without in any way nourishing the body.

No. 2991 was made by Voit in Munich in 1861–62. The object was to investigate whether nitrogen was excreted in the gaseous excretory products. The subject was a dove. The duration of the experiment was 124 days. The food consisted of peas. The nitrogen in the peas was determined. The mean of 5 analyses was 4.77 per cent. The nitrogen in the excreta was also determined, the mean of 12 analyses being taken as representing the average nitrogen content. During the whole experiment the dove consumed 3,132.4 grams peas (water free) = 149.4 grams nitrogen. The excreta weighed 976 grams (water free) and contained 145.9 grams nitrogen. The excreted nitrogen was therefore 3.6 grams less than the amount consumed for the entire period. The dove had, however, gained 70 grams in weight, which, according to Voit's calculation, would account for 2.4 grams nitrogen, thus reducing the discrepancy to 1.2 grams.

The ash in food and excreta was also determined, as a control on the correctness of the nitrogen balance. The food contained 94.6 grams ash and the excreta 94.7 grams. This would indicate that no excrement had been lost. The author selected a dove to experiment with, as up to this time the largest recorded deficit had been found in such experiments.

[This experiment has been much discussed and criticised, but must nevertheless be accepted as accurate. It has become famous as one of the valuable arguments against a respiratory excretion of nitrogen.]

Nos. 2992–2997 were made by Weiske and Mehlis at the Institute for Animal Chemistry at Breslau in 1877 (?). The object was to investigate the digestibility of crude fiber. The subject was a goose. The food consisted of leaves of dandelion (*Leontodon taraxacum*) and the stalks of horse-tail rush (*Equisetum arvense*). The food and excretory products were analyzed. The conclusion was reached that crude fiber was not digested.

Experiments were made by Kalugine[1] to study the influence of consuming fine gravel upon the digestibility of millet by hens. The test was divided into three periods. In two fine gravel was fed with millet and in one powdered coal. The food and excreta were analyzed. The original publication could not be obtained, and the results are therefore not included in the compilation. The digestibility of the food is briefly noted in the Experiment Station Record (8, p. 718), from an abstract[2] of the original publication. The conclusion was reached that fine gravel and also powdered coal increased the coefficients of digestibility of the nutrients, especially of protein and crude fiber.

INFLUENCE OF OTHER CONDITIONS THAN FEEDING.

In Table 31 are included 38 tests with poultry in which the influence of other conditions than feeding was studied. The special questions investigated are noted in the text accompanying the table.

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[1] Selsk. Khoz. i Lyesov., 1896, No. 10.

[2] Fühling's Landw. Ztg., 46 (1897), p. 85.

TABLE 31.—*Experiments with poultry. Influence of other conditions than feeding.*

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		Days.	Gm.	Gm.	Gm.	
2998	1877	Knieriem	Hen	1.4	20 gm. barley grits, 20 cc. water	4	0.3	0.3	0.0	
2999	1877	do	do		do	2	1.2	1.1	+0.1	Subject was given 4.5 gm. asparagin.
3000	1877	do	do		do	1	0.3	0.6	—0.3	Day following No. 2299.
3001	1877	do	do		do	4	0.3	0.4	—0.1	Four days after No. 2299 (including No. 3000).
3002	1877	do	Hen	1.1	25 gm. barley grits, 30 cc. water	4	0.4	0.4	0.0	
3003	1877	do	do		do	1	0.6	0.6	0.0	Subject was given 2.0 gm. aspartic acid.
3004	1877	do	do		do	5	0.4	0.4	0.0	Five days following No. 3009.
3005	1877	do	Hen	1.7	35 gm. barley grits, 45 cc. water	4	0.5	0.6	—0.1	
3006	1877	do	do		do	2	0.9	0.8	+0.1	Subject was given 1 gm. amido acetic acid.
3007	1877	do	do		do	1	0.5	0.6	—0.1	
3008	1877	do	do		do	4	0.5	0.6	—0.1	Four days following No. 3013.
3009	1877	do	Hen	1.3	30 gm. barley grits, 40 cc. water	1	0.5	0.7	—0.2	
3010	1877	do	do		do	5	0.5	0.5	0.0	
3011	1877	do	do		do	1	0.7	0.7	0.0	Subject was given 2.3 gm. leucin.
3012	1877	do	do		do	3	0.5	0.5	0.0	Three days following No. 3011.
3013	1877	do	Hen	1.9	35 gm. barley grits, 45 cc. water	5	0.5	0.7	—0.2	
3014	1877	do	do		do	1	0.7	1.0	—0.3	Subject was given 0.8 gm. ammonium chlorid.
3015	1877	do	do		do	5	0.5	0.7	—0.2	Five days following No. 3014.
3016	1877	do	Hen	1.5	70 gm. barley grits, 200 cc. water	4	1.0	1.1	—0.1	
3017	1877	do	do		do	1	1.3	1.3	0.0	Subject was given 0.8 gm. ammonium chlorid.
3018	1877	do	do		do	4	1.0	1.1	—0.1	Four days following No. 3017.
3019	1877	do	Hen	1.6	40 gm. barley grits, 50 cc. water	3	0.6	0.8	—0.2	
3020	1877	do	do		do	1	0.6	0.8	—0.2	Subject was given 0.3 gm. ammonium chlorid.
3021	1877	do	do		do	3	0.6	0.8	—0.2	Three days after No. 3020.
3022	1880	Fränkel and Röhmann.	Hen 1	1.6	Fasting; — gm. water	4	0.0	0.6	—0.6	
3023	1880	do	do		do	6	0.0	0.7	—0.7	Subject was given 0.022 gm. phosphorus.
3024	1880	do	Hen 2	1.4	do	6	0.0	0.2	—0.2	
3025	1880	do	do		do	8	0.0	1.1	—1.1	Do.
3026	1880	do	Hen 3	1.9	do	5	0.0	0.3	—1.3	
3027	1880	do	do		do	8	0.0	1.0	—1.0	Do.

3028	1884	Weiske and Schulze.	Gander	4.3	190 gm. noodles	12	1.4	1.6	−0.2	
3029	1884	do	do		do	3	3.4	3.5	−0.1	Subject was given aspartic acid.
3030	1884	do	do		do	3	1.4	1.6	−0.2	
3031	1884	do	do		do	3	3.7	3.6	+0.1	Subject was given succinic acid amid.
3032	1884	do	do		do	3	1.4	1.6	−0.2	
3033	1884	do	do		190 gm. meat meal noodles	6	3.6	2.6	+1.0	Subject was given meat meal.
3034	1891	Kornauth	Duck		200 gm. corn	5	3.5	2.7	+0.8	
3035	1891	do	do		do	3	4.0	2.9	+1.1	Subject was given 0.3 gm. saccharinum purum.

Nos. 2998–3001. Ztschr. Biol., 13, p. 45. Nos. 3002–3004. Ibid., p. 48. Nos. 3005–3008. Ibid., p. 50. Nos. 3009–3012. Ibid., p. 53. Nos. 3013–3015. Ibid., p. 62. Nos. 3016–3018. Ibid., p. 64. Nos. 3019–3021. Ibid., p. 67. Nos. 3022, 3023. Ztschr. physiol. Chem., 4, p. 444. Nos. 3024, 3025. Ibid., p. 445. Nos. 3026, 3027. Ibid., p. 446. Nos. 3028, 3029. Ztschr. Biol., 20, p. 283. Nos. 3030–3033. Ibid., p. 284. Nos. 3034, 3035. Landw. Vers. Stat., 38, p. 253.

Nos. 3004–3027 were made by Knieriem at the University of Dorpat in 1877. The object was to study in the organism of a hen the behavior of the compounds which form the intermediate steps in the formation of urea in the organism of Mammalia. The subjects were hens weighing about 1 kilogram. The food consisted of barley grits. The substances fed with the grits were asparagin, aspartic acid, amido acetic acid, leucin, and ammonium chlorid. The period during which these substances were fed was preceded and followed by a period with normal food. A complete analysis of the barley grits was made. The nitrogen in the excreta was determined by the soda-lime method. The uric acid, urea, and ammonia in the excreta were also determined and the nitrogen in the urea calculated.

The author reports an experiment in which a chicken consumed 40 grams of rice and 30 grams of water daily. On the seventh day of the test 0.998 gram of ammonium sulphate was given. The average daily excretion of nitrogen in the feces the first 6 days was 0.1 gram. On the day ammonium sulphate was given the nitrogen excretion was 0.2 gram, and on the 4 following days it averaged 0.1 gram.

The principal conclusions reached were the following: The digestion of protein by hens appears to yield the same compounds as in the case of Mammalia. Aspartic acid, leucin, and amido acetic acid are to be regarded as intermediate steps in the formation of uric acid by the former as well as the latter. In the case of Mammalia, ammonium salts yield urea. In the case of hens they are excreted unchanged. This accounts for the greater amount of ammonia excreted by hens.

Nos. 3022–3027 were made by Fränkel and Röhmann in Berlin in 1879. The object was to study phosphorus poisoning in hens. No food was consumed by the fowls, but phosphorus was fed in bread pills. The nitrogen in the excreta was determined in Nos. 3022 and 3023 by the Dumas method; in the other cases by the soda-lime method. The uric acid in the excreta was also determined.

The conclusion is reached that in phosphorus poisoning of hens the cleavage of protein is very greatly increased, and that the uric acid excretion is also increased. The number of red corpuscles in the blood was also studied. The conclusion was reached that hunger did not diminish their relative number. Phosphorus poisoning, however, diminished the relative number, at first slowly and later very rapidly. In the authors' opinion this shows that the processes of oxidation must be greatly affected by phosphorus poisoning and that diminished metabolism of protein results from diminished oxidation.

Nos. 3028–3033 were made by Weiske and Schulze at the Institute of Animal Chemistry of the University of Breslau in 1884. The object was to study the behavior of several amid compounds in the animal organism. The subject was a gander. The food consisted of noodles made from bran and starch. In No. 3029 aspartic acid was added to the noodles, in No. 3031 succinic acid, and in No. 3033 meat meal. The nitrogen in the food was determined by the soda-lime method. In nearly every case the excrement was evaporated to dryness with and without the addition of hydrochloric acid and the nitrogen in each portion determined. Aspartic acid had practically no influence on the excretion of nitrogen. Succinic acid caused a slight yet marked gain. The greatest gain was made on a diet containing meat meal.

Nos. 3034, 3035, and Nos. 3460–3462, Table 37, were made by Kornauth at the Imperial Experiment Station of Agricultural Chemistry at Vienna in 1871. The experiments form part of a study of saccharin. The subject of Nos. 3034 and 3035 was a duck, and of Nos 3460–3462 a pig. The duck was fed corn. Saccharin was fed with the other food for several days, this period being preceded and followed by a period on normal diet. The duck was fed by stuffing, i. e., the food was forced down its throat, and it choked to death during the second period on normal diet. Complete analyses were made of the food and feces. The conclusions reached are given on page 382.

Experiments were made with rabbits and dogs, but they were not of the sort included in the present compilation.

Experiments were made by Kalugine[1] to study the digestibility of peas, buckwheat,

[1] Zap. Novo-Alexandri Inst. Selsk. i Khoz. Lyesov, 9 (1896), No. 3, pp. 217–257.

wheat, and barley. These experiments were found too late for insertion in the tables. They more properly belong in the preceding section, but owing to limited space are inserted here. Two hens were used as subjects and the tests lasted 7 days, being preceded by a preliminary period of 2 days. Full analyses were made of the food and excretory products. The balance of income and outgo of nitrogen and ash[1] is shown in the following table:

	Food consumed.	Nitrogen.			Ash.		
		In food.	In feces.	Gain (+) or loss (—).	In food.	In feces.	Gain (+) or loss (—).
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Chicken 1	104.9 gm. peas	4.2	3.1	+1.1	2.5	4.3	—1.8
Chicken 2	91.9 gm. peas	3.5	2.8	+0.7	2.2	4.9	—2.7
Chicken 1	80.5 gm. buckwheat	1.6	1.1	+0.5	1.6	1.8	—0.2
Chicken 2	96.9 gm. buckwheat	1.3	1.1	+0.2	1.3	1.5	—0.2
Chicken 1	61.4 gm. wheat	0.9	0.7	+0.2	1.0	1.2	—0.2
Chicken 2	63.4 gm. wheat	0.9	0.8	+0.1	0.9	1.1	—0.2
Chicken 1	70.0 gm. barley	0.9	1.0	—0.1	1.5	1.2	+0.3
Chicken 2	63.8 gm. barley	0.8	0.8	0.0	1.3	1.0	+0.3

In determining the digestibility of protein only that portion of the nitrogen of the feces was taken into account which represented the undigested residue. The total nitrogen in the feces and the nitrogen of uric acid and of ammonia (taken together as representing the nitrogen of urates) and the nitrogen of metabolic products and undigested residue (considered as together representing nitrogen of protein) were determined. The results are shown in the following table:

	Food consumed.	Weight of feces (7 days).	Nitrogen in urates of feces.		Nitrogen in protein of feces.		Total nitrogen in feces.
			Uric acid.	Ammonia.	Metabolic products.	Undigested residue.	
		Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Chicken 1	Peas	353.0	2.53	0.31	2.62	0.72	6.18
Chicken 2	....do	313.5	2.39	0.30	2.76	0.81	6.26
Chicken 1	Buckwheat	171.7	0.47	0.05	2.26	2.04	4.30
Chicken 2	....do	203.0	0.44	0.05	2.07	1.86	3.93
Chicken 1	Wheat	81.8	0.51	0.06	2.73	2.94	6.24
Chicken 2	....do	93.7	0.29	0.03	2.26	3.39	5.97
Chicken 1	Barley	132.0	2.11	0.26	1.55	1.23	5.15
Chicken 2	....do	106.0	2.54	0.31	1.60	0.81	5.26

The following conclusions were drawn from the experiments: In the ability to digest the crude protein of peas and barley chickens do not differ from the ordinary farm animals. In ability to digest the crude protein of buckwheat and wheat they are much inferior. In ability to digest fat they resemble in some respects Herbivora and in other respects swine. Chickens digest nitrogen-free extract very completely. The gravel which hens consume is worn down in the intestinal tract to sand of different degrees of fineness and is excreted in the excretory products.

EXPERIMENTS WITH GOATS.

INFLUENCE OF FEEDING.

In Table 32 are included 33 tests with goats. The animals were all in health. The metabolism balance was usually determined in connection with feeding and digestion experiments or experiments in which some special question was studied.

[1] In the tests with buckwheat, wheat, and barley the sand in the ash of feces was determined. The sand consumed, if any, is not recorded.

TABLE 32.—*Experiments with goats. Influence of feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.					Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	In milk.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3036	1869	Stohmann, Rost, and Frühling.	Goat I	....	1,461 gm. meadow hay	6	23.0	11.0	9.0	3.0	0.0	
3037	1869	.....do	Goat II	....	1,425 gm. meadow hay	6	23.0	9.0	10.0	4.0	0.0	
3038	1869	.....do	Goat I	....	1,284 gm. meadow hay, 200 gm. starch	7	21.0	9.0	10.0	3.0	— 1.0	
3039	1869	.....do	Goat II	....	1,274 gm. meadow hay, 200 gm. starch	7	21.0	6.0	11.0	4.0	0.0	
3040	1869	.....do	Goat I	....	1,440 gm. meadow hay, 50 gm. poppy oil	7	24.0	10.0	10.0	3.0	+ 1.0	
3041	1869	.....do	Goat II	....	1,425 gm. meadow hay, 50 gm. poppy oil	7	24.0	10.0	10.0	4.0	0.0	
3042	1869	.....do	Goat I	....	1,498 gm. meadow hay	7	25.0	11.0	11.0	3.0	0.0	
3043	1869	.....do	Goat II	....	1,488 gm. meadow hay	7	24.0	10.0	10.0	3.0	+ 1.0	
3044	1869	.....do	Goat I	....	1,293 gm. meadow hay, 200 gm. sugar	7	22.0	6.0	12.0	2.0	+ 2.0	
3045	1869	.....do	Goat II	....	1,252 gm. meadow hay, 200 gm. sugar	7	21.0	5.0	10.0	3.0	+ 3.0	
3046	1869	.....do	Goat I	....	1,493 gm. meadow hay	7	22.0	9.0	10.0	2.0	+ 1.0	
3047	1869	.....do	Goat II	....	1,340 gm. meadow hay	7	20.0	7.0	9.0	3.0	+ 1.0	
3048	1869	Stohmann, Lehde, and Baeber.	Goat I	25	1,044 gm. meadow hay, 375 gm. linseed cake, 10 gm. salt, 4,612 gm. water.	11	32.7	10.0	11.1	6.0	+ 5.6	
3049	1869	.....do	.....do	25.4	1,058 gm. meadow hay, 375 gm. linseed cake, 10 gm. salt, 5,380 gm. water.	7	33.4	11.3	11.4	5.5	+ 5.2	
3050	1869	.....do	.....do	25.9	1,062 gm. meadow hay, 375 gm. linseed cake, 10 gm. salt, 4,932 gm. water.	4	33.6	11.1	11.1	5.1	+ 6.3	
3051	1869	.....do	.....do	25.7	846 gm. meadow hay, 375 gm. linseed cake, 10 gm. salt, 50 gm. poppy oil, 4,816 gm. water.	3	30.7	10.7	10.3	5.2	+ 4.5	
3052	1869	.....do	.....do	26.3	925 gm. meadow hay, 338 gm. linseed cake (fat removed), 10 gm. salt, 3,526 gm. water.	4	31.0	10.7	9.3	3.8	+ 7.2	
3053	1869	.....do	.....do	33.9	1,102 gm. meadow hay, 428 gm. linseed cake (fat removed), 10 gm. salt, 3,295 gm. water.	4	43.3	14.4	9.4	4.3	+15.2	
3054	1869	.....do	.....do	26.2	820 gm. meadow hay, 375 gm. linseed cake, 10 gm. salt, 4,249 gm. water.	4	30.2	12.3	9.3	3.2	+ 5.4	
3055	1869	.....do	.....do	26.7	769 gm. meadow hay, 338 gm. linseed cake (Berlin), 90 gm. starch, 10 gm. salt, 3,736 gm. water.	4	30.3	12.1	9.1	3.0	+ 6.1	
3056	1869	.....do	.....do	25.9	500 gm. meadow hay, 338 gm. linseed cake (Berlin), 215 gm. starch, 10 gm. salt, 2,865 gm. water.	4	26.4	9.7	7.1	3.0	+ 6.6	
3057	1869	.....do	Goat II	31.7	1,160 gm. meadow hay, 375 gm. linseed cake, 10 gm. salt, 3,499 gm. water.	9	34.4	10.8	11.6	6.9	+ 5.1	
3058	1869	.....do	.....do	32.3	1,177 gm. meadow hay, 475 gm. linseed cake, 10 gm. salt, 4,104 gm. water.	6	39.9	13.7	12.0	7.3	+ 6.9	

3059	1869	.....do	.....do	32.3	1,050 gm. meadow hay, 475 gm. linseed cake, 50 gm. poppy oil, 10 gm. salt, 4,433 gm. water.	4	38.4	14.1	11.6	7.7	+ 5.0
3060	1869	.....do	.....do	32.9	1,135 gm. meadow hay, 475 gm. linseed cake, 10 gm. salt, 4,302 gm. water.	4	39.0	14.6	10.7	6.9	+ 6.8
3061	1869	.....do	.....do	32.7	1,134 gm. meadow hay, 475 gm. linseed cake, 10 gm. salt, 3,492 gm. water.	3	39.3	14.7	11.9	6.5	+ 6.2
3062	1869	.....do	.....do	33.4	1,158 gm. meadow hay, 475 gm. linseed cake, 10 gm. salt, 3,239 gm. water.	4	38.4	14.6	13.3	5.2	+ 5.3
3063	1869	.....do	.....do	33.9	1,102 gm. meadow hay, 428 gm. linseed cake (fat removed), 10 gm. salt, 3,295 gm. water.	4	38.4	13.5	11.0	4.7	+ 9.2
3064	1869	.....do	.....do	33.7	644 gm. meadow hay, 856 gm. linseed cake (Berlin), 10 gm. salt, 3,065 gm. water.	4	61.9	26.3	13.1	5.2	+17.3
3065	1869	.....do	.....do	34.2	1,052 gm. meadow hay, 389 gm. linseed cake, 10 gm. salt, 2,883 gm. water.	4	34.0	14.8	9.4	3.8	+ 6.0
3066	1869	.....do	.....do	33.2	586 gm. meadow hay, 428 gm. linseed cake, 232 gm. starch, 10 gm. salt, 1,922 gm. water.	4	32.7	12.5	8.9	3.7	+ 7.6
3067	1869	Stohmann	Goat II	....	700 gm. hay, 800 gm. oil-free linseed meal ..	21	52.1	28.9	11.6	8.2	+ 3.4
3068	1869	.....do	.....do	....	591 gm. hay, 200 gm. starch, 200 gm. gum.....	7	8.6	2.6	5.9	2.7	— 2.6

Nos. 3036–3047. Landw. Vers. Stat., 11, p. 206. No. 3048. Jour. Landw., 1868, pp. 165, 180; 1869, pp. 19, 20. No. 3049. Ibid., 1868, pp. 166, 181; 1869, pp. 21, 22. No. 3050. Ibid., 1868, pp. 167, 181; 1869, pp. 23, 24. No. 3051. Ibid., 1868, pp. 316, 321; 1869, pp. 27, 28. No. 3052. Ibid., 1868, pp. 421, 425; 1869, p. 30. No. 3053. Ibid., 1868, pp. 422, 433; 1869, pp. 31, 32. No. 3054. Ibid., 1868, pp. 438, 441; 1869, pp. 130, 131. No. 3055. Ibid., 1868, pp. 444, 448; 1869, pp. 132, 133. No. 3056. Ibid., 1868, pp. 445, 448; 1869, pp. 134, 135. No. 3057. Jour. Landw., 1868, pp. 171, 182; 1869, pp. 136, 137. No. 3058. Ibid., 1868, pp. 308, 310; 1869, pp. 138, 139. No. 3059. Ibid., 1868, pp. 314, 321; 1869, pp. 140, 141. No. 3060. Ibid., 1868, pp. 325, 330; 1869, pp. 142, 143. No. 3061. Ibid., 1868, pp. 326, 330; 1869, pp. 144, 145. No. 3062. Ibid., 1868, pp. 327, 330; 1869, pp. 146, 147. No. 3063. Ibid., 1868, pp. 422, 425; 1869, pp. 148, 149. No. 3064. Ibid., 1868, pp. 430, 433; 1869, pp. 150, 151. No. 3065. Ibid., 1868, pp. 439, 441; 1869, pp. 152, 153. No. 3066. Ibid., 1868, pp. 446, 449; 1869, pp. 154, 155. No. 3067. Landw. Vers. Stat., 12, p. 397. No. 3068. Ibid., p. 401.

Nos. 3036–3047 were made by Stohmann, Rost, and Frühling at the experiment station in Halle in 1868. The object was to investigate the validity of Voit's theory that no nitrogen is excreted except in the solid and liquid excretory products. Two goats were used as subjects. The food consisted of meadow hay, and in several cases starch, poppy oil, or sugar was also fed. The nitrogen in food, urine, feces, and milk was determined. In Nos. 3036–3042 practically all the nitrogen consumed was recovered in the urine, feces, and milk. In Nos. 3043–3047 the amount which was not recovered could be accounted for by the gain in weight of the animal.

The author's conclusion is that Voit's theory holds good for goats; that is, nitrogen is excreted only in the urine and feces. Protein metabolism is dependent upon the amount of circulating protein in the body. Increased consumption of water increases the metabolism of nitrogen. Nitrogen metabolism rapidly adjusts itself to changes in the amount of nitrogen consumed. When the food contains insufficient nitrogen the body loses protein. There is a noticeable gain in weight when the food contains an abundance of fat and carbohydrates in addition to sufficient protein.

Nos. 3048–3066 were made by Stohmann, Lehde, and Baeber at Halle in 1866. The object was to study the metabolism of nutrients during the period of lactation. The subjects were two goats. The food consisted of meadow hay and linseed cake of several kinds, with a little salt. In several cases poppy oil or starch was fed also. Analyses were made of food, urine, and feces.

Among the conclusions reached were the following: Some nitrogen leaves the body in other ways than in the solid and liquid excretory products. The protein content of the milk is not dependent upon the composition of the food, but is dependent upon the length of the period of lactation.

Nos. 3067, 3068 were made by Stohmann at the experiment station in Halle in 1867. The object was to determine whether the laws of nitrogen metabolism which Voit had formulated for Carnivora held good for Herbivora also. The subject was a goat. The food in No. 3067 consisted of hay, with oil-free linseed meal, and in No. 3068 of hay, with starch and gum. Food, urine, feces, and milk were analyzed. The conclusion was reached that the protein is metabolized in Herbivora as in Carnivora.

Stohmann reports his experiments with goats in another publication.[1] Some of the figures agree with those quoted above, while others do not. The inference of the compilers is that the same experiments are referred to in each case. The apparent discrepancy is probably due to the fact that in one instance averages are given and in the other more detailed statements.

EXPERIMENTS WITH HORSES.

INFLUENCE OF FEEDING.

In Table 33 are included 198 tests with horses. The number of investigators who have studied the metabolism of horses is not large, and a review of the literature of the subject shows that comparatively few feeding experiments have been made. Much of the work has been done for the purpose of studying the best methods of feeding. In some cases the balance of income and outgo of nitrogen has been determined in connection with feeding and digestion experiments. In many experiments the influence of muscular work of varying kinds and amounts has been investigated. The conclusions drawn from the experiments in the following table have been much quoted in discussions concerning the economic feeding of horses.

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[1] Biologische Studien, 1873. Braunschweig.

TABLE 33.—*Experiments with horses. Influence of feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3069	1839	Boussingault	Horse		7,500 gm. hay, 2,270 gm. oats, 16,000 gm. water.		139.4	37.8	77.6	+24.0	
3070	1865	Hofmeister	Horse		2,615 gm. hay, 3,090 gm. oats, 500 gm. rye straw, 12,785 gm. water.	1	92.8	35.0	35.2	+22.6	
3071	1865	do	do		do	1	92.8	55.0	31.2	+ 6.6	
3072	1866	do	Horse		7,255 gm. hay, 17,930 gm. water	1	105.9	65.0	58.4	—17.5	
3073	1866	do	do		do	1	105.9	65.0	55.0	—14.9	
3074	1866	do	do		3,000 gm. hay, 3,094 gm. oats, 500 gm. rye straw, 11,190 gm. water.	1	87.0	45.0	25.5	+16.5	
3075	1866	do	do		do	1	87.0	50.0	29.0	+ 8.0	
3076	1879	Kellner	Horse	534	5,000 gm. meadow hay, 6,000 gm. oats, 1,500 gm. wheat straw, 12 gm. salt.	6	189.7	99.0	55.3	+35.4	Work done=475,000 kilogrammeters.
3077	1879	do	do		do	10	189.7	109.3	61.4	+19.0	Work done=950,000 kilogrammeters.
3078	1879	do	do		do	14	189.7	116.8	57.0	+15.9	Work done=1,425,000 kilogrammeters.
3079	1879	do	do		do	12	189.7	110.2	63.3	+16.2	Work done=940,000 kilogrammeters.
3080	1879	do	do		do	14	189.7	98.3	60.3	+31.1	Work done=475,000 kilogrammeters.
3081	1883	Grandeau and Le Clere.	Horse No. 1	422	1,044 gm. hay, 564 gm. straw, 1,968 gm. oats, 420 gm. beans, 1,452 gm. maize, 288 gm. "maize cake."	30	94.0	59.2	23.6	+11.2	November, 1880, rest.
3082	1883	do	do		do	31	91.9	65.1	19.8	+ 7.0	January, 1881, rest.
3083	1883	do	do		do	31	92.8	64.7	23.1	+ 5.0	March, 1881, rest.
3084	1883	do	do		1,148 gm. hay, 620 gm. straw, 2,164 gm. oats, 464 gm. beans, 1,600 gm. maize, 316 gm. "maize cake."	28	103.5	75.0	25.1	+ 3.4	February, 1881, walking.
3085	1883	do	do		do	30	102.2	72.7	29.8	— 0.3	April, 1880, trotting.
3086	1883	do	do		1,568 gm. hay, 848 gm. straw, 2,952 gm. oats, 632 gm. beans, 2,180 gm. maize, 432 gm. "maize cake."	31	137.7	92.3	36.2	+ 9.2	December, 1880, work, walking.
3087	1883	do	do		do	31	140.1	82.4	48.2	+ 9.5	May, 1881, work, trotting.
3088	1883	do	Horse No. 2	429	Same as No. 3081	30	94.0	44.5	30.0	+19.5	November, 1880, rest.
3089	1883	do	do		do	28	94.0	53.5	28.7	+11.8	February, 1881, rest.
3090	1883	do	do		do	30	92.8	56.0	27.7	+ 9.1	April, 1881, rest.
3091	1883	do	do		Same as No. 3084	31	101.8	63.7	30.4	+ 7.7	December, 1880, walking.

TABLE 33.—*Experiments with horses. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3092	1883	Grandeau and Le Clerc.	Horse No. 2		Same as No. 3084	31	103.9	60.3	36.2	+ 7.4	May, 1881, trotting.
3093	1883	do	do		Same as No. 3086	31	136.6	68.9	44.4	+23.3	January, 1881, work, walking.
3094	1883	do	do		do	31	130.6	74.3	47.2	+ 9.1	March, 1881, work, trotting.
3095	1883	do	Horse No. 3	449	Same as No. 3081	30	94.0	60.6	21.2	+12.2	November, 1880, rest.
3096	1883	do	do		do	31	92.8	61.3	21.9	+ 9.6	December, 1880, rest.
3097	1883	do	do		do	31	94.3	59.6	25.4	+ 9.3	May, 1881, rest.
3098	1883	do	do		Same as No. 3084	31	100.6	68.5	24.3	+ 7.8	January, 1881, walking.
3099	1883	do	do		do	31	102.2	66.2	30.4	+ 5.6	March, 1881, trotting.
3100	1883	do	do		Same as No. 3086	28	141.2	91.9	35.9	+13.4	February, 1881, work, walking.
3101	1883	do	do		do	30	138.6	85.5	41.1	+12.0	April, 1881, work, trotting.
3102	1887	do	Horse No. 1	407	8,800 gm. hay	30	91.2	35.8	52.3	+ 3.1	November, 1883, walking. In Nos. 3102–3119 nitrogen of the feces includes 1.5 gm. from hair, hoofs, etc.
3103	1887	do	do		12,000 gm. hay	31	132.5	55.3	76.1	+ 1.1	December, 1883, work, walking.
3104	1887	do	do		8,000 gm. hay	31	89.9	35.2	47.0	+ 7.7	January, 1884, rest.
3105	1887	do	do		14,815 gm. hay	31	161.8	71.2	93.2	— 2.6	March, 1884, work, trotting.
3106	1887	do	do		8,000 gm. hay	30	87.8	38.8	56.0	— 7.0	April, 1884, rest.
3107	1887	do	do		10,000 gm. hay	31	119.0	40.1	70.6	+ 8.3	May, 1884, trotting.
3108	1887	do	Horse No. 2	424	8,000 gm. hay	30	82.9	30.7	48.7	+ 3.5	November, 1883, rest.
3109	1887	do	do		8,800 gm. hay	31	97.1	44.7	51.4	+ 1.0	December, 1883, walking.
3110	1887	do	do		12,000 gm. hay	31	134.9	70.2	66.6	— 1.9	January, 1884, work, walking.
3111	1887	do	do		10,000 gm. hay	31	109.2	46.5	69.7	— 7.0	March, 1884, trotting.
3112	1887	do	do		15,130 gm. hay	30	166.0	73.7	91.6	+ 0.7	April, 1884, work, trotting.
3113	1887	do	do		8,000 gm. hay	31	95.2	41.9	51.7	+ 1.6	May, 1884, rest.
3114	1887	do	Horse No. 3	424	12,000 gm. hay	30	124.4	54.5	74.7	— 4.8	November, 1883, work, walking.
3115	1887	do	do		8,000 gm. hay	31	88.3	37.6	50.1	+ 0.6	December, 1883, rest.
3116	1887	do	do		8,800 gm. hay	31	98.9	46.9	50.0	+ 2.0	January, 1884, walking.
3117	1887	do	do		8,000 gm. hay	31	87.4	32.7	68.7	—14.0	March, 1884, rest.
3118	1887	do	do		10,000 gm. hay	30	109.7	45.2	79.6	—15.1	April, 1884, trotting.
3119	1887	do	do		16,000 gm. hay	31	190.4	78.6	130.0	—18.2	May, 1884, work, trotting.
3120	1887	Wolff	Horse	476.9	6,000 gm. meadow hay, 5,000 gm. oats	6	180.8	128.2	52.9	— 0.3	Ash in food, 82.3 gm.; in urine, 29.1 gm.; in feces, 55.2 gm.; loss, 2.0 gm.
3121	1887	do	do	479.3	6,000 gm. meadow hay, 5,000 gm. oats, 1,000 gm. straw.	12	187.1	129.4	57.0	+ 0.7	Ash in food, 46.4 gm.; in urine, 16.1 gm.; in feces, 34.4 gm.; loss, 4.1 gm.

3122	1887	....do	....do	477.4	6,000 gm. meadow hay, 2 500 gm. oats, 1,000 gm. straw, 2,500 gm. beans.	12	242.5	174.9	69.2	— 1.6	Ash in food, 45 0 gm.; in urine, 17.3 gm.; in feces, 29.8 gm.; loss, 2.1 gm.
3123	1887	....do	....do	476.8	....do	6	240.6	175.0	67.0	— 1.4	
3124	1887	....do	....do	473.0	....do	10	244.5	173.2	64.3	+ 7.0	
3125	1887	....do	....do	472.8	6,000 gm. meadow hay, 2,500 gm. oats, 1,000 gm. straw, 2,500 gm. beans, 750 gm. flaxseed.	9	251.3	181.0	70.8	— 0.5	
3126	1887	....do	....do	474.6	6,000 gm. hay. 1,000 gm. straw, 2,500 gm. oats, 2,500 gm. maize.	10	190.6	114.5	69.3	+ 6.8	Ash in food, 52.5 gm.; in urine, 19.6 gm.; in feces, 32.8 gm.; gain, 0.1 gm.
3127	1887	....do	....do	475.8	....do	8	190.6	112.3	67.5	+10.8	
3128	1887	....do	....do	478.4	....do	16	184.8	117.2	61.5	+ 6.1	The maize was soaked in water before feeding.
3129	1887	....do	....do	472.2	7,000 gm. hay, 5,000 gm. oats	10	205.3	131.5	64.3	+ 9.5	
3130	1887	....do	....do	476.5	12,000 gm. hay	9	201.3	117.8	82.4	+ 1.1	
3131	1887	....do	....do	477.6	7,000 gm. hay, 5,500 gm. oats	6	210.5	123.8	76.4	+10.3	
3132	1887	....do	....do	478.0	....do	6	211.4	123.6	77.9	+ 9.9	
3133	1887	....do	....do	477.2	....do	6	210.6	132.0	80.1	— 1.5	
3134	1887	....do	....do	477.8	....do	6	210.6	127.5	79.0	+ 4.1	
3135	1887	....do	....do	479 0	....do	6	208.4	123.2	77.9	+ 7.3	
3136	1887	....do	....do	478.1	....do	6	211.5	123.2	82.1	+ 6.2	
3137	1887	....do	....do	475.8	5,000 gm. hay, 5,500 gm. oats	10	179.5	107.1	64.7	+ 7.7	
3138	1887	....do	....do	471.2	3,000 gm. hay, 5,500 gm. oats	10	148.7	92.6	48.5	+ 7.6	
3139	1887	....do	....do	472.9	3,000 gm. hay, 7,000 gm. oats	6	172.1	111.8	51.3	+ 9.0	
3140	1887	....do	....do	472.2	....do	6	172.1	115.8	51.4	+ 4.9	
3141	1887	....do	....do	479.6	7,000 gm. hay, 3,500 gm. maize	6	174.0	92.0	70.1	+11.9	
3142	1887	....do	....do	479.6	....do	6	174.0	96.6	73.1	+ 4.3	
3143	1887	....do	....do	479.3	11,000 gm. hay	6	183.6	105.8	91.3	—13.5	
3144	1889	Grandeau and Le Clerc.	Horse No. 1	407	5,710.6 gm. oats	31	98.3	71.9	28.8	— 2.4	December, 1885, work, walking. In Nos. 3144–3181 the nitrogen of the feces includes a small amount from perspiration, hair, and hoofs.
3145	1889	....do	....do		4,233.3 gm. oats	30	75.4	69.9	17.1	—11.6	April–May, 1886, work, walking.
3146	1889	....do	....do		4,434.3 gm. oats	30	79.0	49.8	19.1	+10.1	May–June, 1886, walking.
3147	1889	....do	....do		4,146.6 gm. oats	9	70.2	50.8	19.6	— 0.2	June, 1886, work.
3148	1889	....do	Horse No. 2	400	4,808.7 gm. oats	16	84.7	83.1	12.9	—11.3	December, 1885, walking.
3149	1889	....do	....do		3,931.9 gm. oats	31	62.8	54.5	11.9	— 3.6	January, 1886, walking.
3150	1889	....do	....do		3,846.7 gm. oats	30	68.9	68.6	13.5	—13.2	May–June, 1885, work, walking.
3151	1889	....do	Horse No. 3	414	4,646.5 gm. oats	31	81.5	63.2	15.2	+ 3.1	December, 1885, rest.
3152	1889	....do	....do		4,293.5 gm. oats	31	66.9	56.8	16.1	— 6.0	January. 1886, work, walking.
3153	1889	....do	....do		3,816.7 gm. oats	30	68.4	58.6	14.2	— 4.4	April–May, 1886, walking.
3154	1889	....do	....do		4,281 gm. oats	30	76.7	70.1	16.5	— 9.9	May–June, 1886, rest.
3155	1889	....do	....do		3,470 gm. oats	9	57.0	54.2	16.1	– 13.2	June, 1886, rest.
3156	1889	....do	Horse No. 1	372	4,498.4 gm. oats, 1,346.7 gm. oat straw	30	91.1	49.1	28.9	+13.1	July, 1886, rest.
3157	1889	....do	....do		5,500 gm. oats, 2,250 gm. oat straw	31	113.8	51.3	31.9	+30.6	August, 1886, rest.
3158	1889	....do	....do		5,500 gm. oats, 2,500 gm. oat straw	30	106.2	51.5	33.0	+21.7	September, 1886, rest.
3159	1889	....do	....do		....do	31	107.5	51.6	33.3	+22.6	October, 1886, rest.
3160	1889	....do	....do		....do	30	106.0	51.2	32.7	+22.1	November, 1886, rest.
3161	1889	....do	....do		....do	31	102.3	54.6	33.3	+14.4	December, 1886, rest.
3162	1889	....do	....do		....do	31	101.9	65.7	31.1	+ 5.1	January, 1887, work, walking.
3163	1889	....do	....do		....do	28	103.0	57.3	32.5	+13.2	February, 1887, work, walking.

TABLE 33.—*Experiments with horses. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3164	1889	Grandeau and Le Clerc.	Horse No. 1		5,500 gm. oats, 2,500 gm. oat straw	31	98.1	53.2	31.9	+13.0	March, 1887, work, trotting.
3165	1889	do	do		6,500 gm. oats, 2,500 gm. oat straw	30	113.9	67.9	39.5	+ 6.5	April, 1887, work, trotting.
3166	1889	do	do		7,000 gm. oats, 2,500 gm. oat straw	31	125.7	67.4	46.7	+11.6	May, 1887, work, trotting.
3167	1889	do	do		do	31	122.7	55.7	42.7	+24.3	June, 1887, work, trotting.
3168	1889	do	do		7,000 gm. oats, 2,420 gm. oat straw	31	126.9	55.7	52.8	+18.4	July, 1887, work (wagon).
3169	1889	do	Horse No. 3	354	4,772.7 gm. oats, 1,346.7 gm. oat straw	31	91.9	43.6	33.2	+15.1	July, 1886, rest.
3170	1889	do	do		5,500 gm. oats, 2,250 gm. oat straw	31	113.8	48.4	35.6	+29.8	August, 1886, rest.
3171	1889	do	do		5,500 gm. oats, 2,500 gm. oat straw	30	106.2	44.2	45.1	+16.9	September, 1886, rest.
3172	1889	do	do		do	31	107.5	44.4	43.1	+20.0	October, 1886, rest.
3173	1889	do	do		do	30	106.0	45.9	40.4	+19.7	November, 1886, rest.
3174	1889	do	do		do	31	102.3	52.1	41.4	+ 8.8	December, 1886, rest.
3175	1889	do	do		do	31	101.9	56.7	38.2	+ 7.0	January, 1887, walking.
3176	1889	do	do		do	28	103.0	59.7	38.5	+ 4.8	February, 1887, work, walking.
3177	1889	do	do		6,500 gm. oats, 2,500 gm. oat straw	31	114.1	63.4	47.0	+ 3.7	March, 1887, work, trotting.
3178	1889	do	do		do	30	98.1	49.9	43.3	+ 4.9	April, 1887, trotting.
3179	1889	do	do		7,000 gm. oats, 2,500 gm. oat straw	31	125.7	58.6	52.3	+14.8	May, 1887, work, trotting.
3180	1889	do	do		do	30	122.7	59.1	53.6	+10.0	June, 1887, work, trotting.
3181	1889	do	do		do	31	127.4	59.1	55.2	+13.1	July, 1887, work (wagon).
3182	1892	Grandeau, LeClerc, and Ballacey.	Horse No. 1	439	6,000 gm. maize, 2,500 gm. oat straw	21	63.6	48.3	39.3	—24.0	November, 1887, walking.
3183	1892	do	do		5,714 gm. maize, 2,316 gm. oat straw	19	70.6	54.4	38.5	—22.3	November-December, 1887, work, walking.
3184	1892	do	do		4,800 gm. maize, 2,000 gm. oat straw	20	68.9	38.9	24.6	+ 5.4	December, 1887, rest.
3185	1892	do	do		4,000 gm. maize, 2,500 gm. oat straw	31	50.8	39.0	30.1	—18.3	January, 1888, rest.
3186	1892	do	do		4,655 gm. maize, 2,327 gm. oat straw	29	49.8	39.6	29.5	—19.3	February, 1888, trotting.
3187	1892	do	do		4,355 gm. maize, 2,177 gm. oat straw	31	51.2	43.4	29.2	—21.4	March, 1888, work, trotting.
3188	1892	do	Horse No. 2	479	6,000 gm. maize, 3,000 gm. oat straw	21	60.6	44.0	49.5	—32.9	November, 1887, rest.
3189	1892	do	do		do	19	63.2	45.9	51.6	—34.3	November-December, 1887, walking.
3190	1892	do	do		do	20	70.6	60.5	45.5	—35.4	December, 1887, work, walking.
3191	1892	do	do		do	31	56.7	50.8	59.9	—54.0	January, 1888, work, trotting.
3192	1892	do	do		5,000 gm. maize, 3,000 gm. oat straw	29	45.6	36.3	40.8	—31.5	February, 1888, rest.
3193	1892	do	do		do	31	41.2	39.0	51.1	—48.9	March, 1888, trotting.
3194	1892	do	Horse No. 3	440	6,000 gm. maize, 2,500 gm. oat straw	21	57.4	53.4	51.3	—47.3	November, 1887, work, walking.
3195	1892	do	do		5,700 gm. maize, 2,375 gm. oat straw	19	71.0	43.8	36.7	— 9.5	November-December, 1887, rest.
3196	1892	do	do		6,000 gm. maize, 2,500 gm. oat straw	20	77.3	46.3	36.4	— 5.4	December, 1887, walking.

3197	1892	.....do	.....do	....	5,000 gm. maize, 2,500 gm. oat straw	31	68.4	42.1	44.7	—18.4	January, 1888, trotting.
3198	1892	.....do	.....do	....	6,000 gm. maize, 2,500 gm. oat straw	29	62.5	44.4	36.4	—18.3	February, 1888, work, trotting.
3199	1892	.....do	.....do	....	4,000 gm. maize, 2,500 gm. oat straw	31	40.3	33.7	34.4	—27.8	March, 1888, rest.
3200	1892	.....do	Horse No. 1	....	3,407 gm. maize, 2,128 gm. wheat straw	21	51.1	37.1	28.3	—14.3	November, 1888, walking.
3201	1892	.....do	.....do	....	3,647 gm. maize, 1,477 gm. wheat straw	19	47.3	41.9	22.6	—17.2	November-December, 1888, work, walking.
3202	1892	.....do	.....do	....	3,206 gm. maize, 1,755 gm. wheat straw	20	49.9	38.8	22.2	—11.1	December, 1888, rest.
3203	1892	.....do	.....do	....	3,414 gm. maize, 2,050 gm. wheat straw	31	47.4	34.7	23.0	—10.3	January, 1889, rest.
3204	1892	.....do	.....do	....	3,726 gm. maize, 1,779 gm. wheat straw	28	57.0	45.2	21.4	— 9.6	February, 1889, trotting.
3205	1892	.....do	.....do	....	4,160 gm. maize, 1,702 gm. wheat straw	31	68.2	50.8	22.8	— 5.4	March, 1889, work, trotting.
3206	1892	.....do	Horse No. 2	....	4,826 gm. maize, 2,216 gm. wheat straw	21	78.9	41.1	29.4	+ 8.4	November, 1888, rest.
3207	1892	.....do	.....do	....	4,242 gm. maize, 2,043 gm. wheat straw	19	57.8	35.3	30.8	— 8.3	November-December, 1888, walking.
3208	1892	.....do	.....do	....	4,553 gm. maize, 1,652 gm. wheat straw	20	67.6	50.0	31.7	—14.1	December, 1888, work, walking.
3209	1892	.....do	.....do	....	4,956 gm. maize, 1,753 gm. wheat straw	31	62.6	45.7	33.0	—16.1	January, 1889, work, trotting.
3210	1892	.....do	.....do	....	4,174 gm. maize, 2,077 gm. wheat straw	28	57.1	34.8	33.4	—11.1	February, 1889, rest.
3211	1892	.....do	.....do	....	4,175 gm. maize, 2,111 gm. wheat straw	31	58.8	35.4	36.0	—12.6	March, 1889, trotting.
3212	1892	.....do	Horse No. 3	....	4,258 gm. maize, 2,128 gm. wheat straw	21	63.9	42.7	30.9	— 9.7	November, 1888, work, walking.
3213	1892	.....do	.....do	....	3,394 gm. maize, 2,087 gm. wheat straw	19	44.4	41.9	28.2	—25.7	November-December, 1888, rest.
3214	1892	.....do	.....do	....	4,216 gm. maize, 2,065 gm. wheat straw	20	63.7	43.8	28.8	— 8.9	December, 1888, walking.
3215	1892	.....do	.....do	....	4,171 gm. maize, 2,010 gm. wheat straw	31	59.1	36.1	23.5	— 0.5	January, 1889, trotting.
3216	1892	.....do	.....do	....	4,829 gm. maize, 2,077 gm. wheat straw	28	72.7	50.5	28.1	— 5.9	February, 1889, work, trotting.
3217	1892	.....do	.....do	....	3,340 gm. maize, 2,111 gm. wheat straw	31	49.7	34.7	28.3	—13.3	March, 1889, rest.
3218	1893	Grandeau and Ballacey.	Horse No. 1	477	4,500 gm. horse beans, 4,000 gm. oat straw	31	157.8	133.0	60.3	—35.5	December, 1889, rest.
3219	1893	.....do	.....do	....	5,000 gm. horse beans, 4,000 gm. oat straw	31	160.8	134.1	66.7	—40.0	January, 1890, walking.
3220	1893	.....do	.....do	....	6,000 gm. horse beans, 4,000 gm. oat straw	28	208.1	156.4	83.9	—32.2	February, 1890, work, walking.
3221	1893	.....do	.....do	....	7,000 gm. horse beans, 3,290 gm. oat straw	31	209.0	166.7	85.4	—43.1	March, 1890, work, trotting.
3222	1893	.....do	.....do	....	4,000 gm. horse beans, 4,000 gm. oat straw	30	130.5	98.4	59.0	—26.9	April, 1890, rest.
3223	1893	.....do	.....do	....	5,000 gm. horse beans, 4,000 gm. oat straw	31	140.8	101.8	75.7	—36.7	May, 1890, trotting.
3224	1893	.....do	.....do	....	4,000 gm. horse beans, 4,000 gm. oat straw	31	112.8	87.7	65.9	—40.8	August, 1890, rest.
3225	1893	.....do	.....do	....	4,133 gm. horse beans, 4,000 gm. oat straw	30	126.4	89.1	65.9	—28.6	September, 1890, rest.
3226	1893	.....do	Horse No. 2	475	5,000 gm. horse beans, 4,000 gm. oat straw	31	184.5	159.9	54.2	—29.6	December, 1889, walking.
3227	1893	.....do	.....do	....	6,000 gm. horse beans, 4,000 gm. oat straw	31	209.7	170.9	60.4	—21.6	January, 1890, work, walking.
3228	1893	.....do	.....do	....	4,500 gm. horse beans, 4,000 gm. oat straw	28	170.1	133.6	52.3	—15.8	February, 1890, rest.
3229	1893	.....do	.....do	....	4,000 gm. horse beans, 4,000 gm. oat straw	31	131.5	108.5	46.1	—23.1	March, 1890, rest.
3230	1893	.....do	.....do	....	5,000 gm. horse beans, 4,000 gm. oat straw	30	168.4	142.7	60.1	—34.4	April, 1890, trotting.
3231	1893	.....do	.....do	....	7,000 gm. horse beans, 3,710 gm. oat straw	31	200.4	159.7	86.1	—45.4	May, 1890, work, trotting.
3232	1893	.....do	.....do	....	4,000 gm. horse beans, 4,000 gm. oat straw	30	123.6	101.2	49.9	—27.5	June, 1890, rest.
3233	1893	.....do	.....do		.....do	31	129.4	105.6	46.4	—22.6	July, 1890, rest.
3234	1893	.....do	Horse No. 3	461	6,000 gm. horse beans, 4,000 gm. oat straw	31	223.2	202.2	63.8	—42.8	December, 1889, work, walking.
3235	1893	.....do	.....do	....	4,056 gm. horse beans, 4,064 gm. oat straw	31	145.1	121.5	42.8	—19.2	January, 1890, rest.
3236	1893	.....do	.....do	....	5,000 gm. horse beans, 4,000 gm. oat straw	28	193.1	134.8	53.5	+ 4.8	February, 1890, walking.
3237	1893	.....do	.....do	....	5,000 gm. horse beans, 3,855 gm. oat straw	31	172.4	125.4	44.9	+ 2.1	March, 1890, trotting.
3238	1893	.....do	.....do	....	7,000 gm. horse beans, 3,333 gm. oat straw	30	240.4	168.1	78.2	— 5.9	April, 1890, work, trotting.
3239	1893	.....do	.....do	....	3,742 gm. horse beans, 3,323 gm. oat straw	31	120.5	95.8	44.9	—20.2	May, 1890, rest.
3240	1893	.....do	.....do	....	4,000 gm. horse beans, 3,511 gm. oat straw	30	124.8	89.7	48.3	—13.2	June, 1890, rest.
3241	1893	.....do	.....do	....	4,000 gm. horse beans, 3,542 gm. oat straw	31	121.0	100.0	58.9	—37.9	July, 1890, rest.
3242	1896	Grandeau, Ballacey and Alekan.	Horse No. 1	478	5,317 gm. "maize cake," 4,217 gm. oat straw	30	119.5	85.5	71.5	—37.5	June, 1891, work, walking. In Nos. 3242-3267 the quantities of food given are those actually consumed.

TABLE 33.—*Experiments with horses. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3243	1896	Grandeau, Ballacey and Alekan.	Horse No. 1		4,000 gm. "maize cake," 4,000 gm. oat straw.	31	95.7	65.4	49.0	—18.7	July, 1891, rest.
3244	1896	do	do		4,500 gm. "maize cake," 4,500 gm. oat straw.	31	85.5	61.9	60.6	—37.0	August, 1891, walking.
3245	1896	do	do		6,500 gm. "maize cake," 4,333 gm. oat straw.	30	140.8	120.1	84.3	—63.6	September, 1891, work, trotting.
3246	1896	do	do		4,000 gm. "maize cake," 4,000 gm. oat straw.	31	84.1	76.1	51.0	—43.0	October, 1891, rest.
3247	1896	do	do		5,500 gm. "maize cake," 5,500 gm. oat straw.	30	131.9	90.6	69.0	—27.7	November, 1891, trotting.
3248	1896	do	do		4,000 gm. "maize cake," 4,000 gm. oat straw.	29	86.8	82.4	59.9	—65.5	February, 1892, rest.
3249	1896	do	do		do	31	99.0	73.5	53.5	—28.0	March, 1892, rest.
3250	1896	do	do		do	30	87.2	78.6	57.7	—49.1	April, 1892, rest.
3251	1896	do	Horse No. 2	505	4,500 gm. "maize cake," 4,500 gm. oat straw.	30	106.2	84.9	60.4	—39.1	June, 1892, walking.
3252	1896	do	do		5,500 gm. "maize cake," 5,500 gm. oat straw.	31	126.4	107.1	70.2	—50.9	July, 1891, work, walking.
3253	1896	do	do		4,000 gm. "maize cake," 4,000 gm. oat straw.	31	83.6	64.1	46.0	—26.5	August, 1891, rest.
3254	1896	do	do		5,500 gm. "maize cake," 5,500 gm. oat straw.	30	138.3	102.1	56.1	—19.9	September, 1891, trotting.
3255	1896	do	do		6,500 gm. "maize cake," 4,145 gm. oat straw.	31	138.7	119.4	67.2	—47.9	October, 1891, work, trotting.
3256	1896	do	do		4,000 gm. "maize cake," 4,000 gm. oat straw.	30	96.2	89.3	52.5	—45.6	November, 1891, rest.
3257	1896	do	do		do	31	95.7	84.4	46.9	—35.6	December, 1891. rest.
3258	1896	do	do		do	31	97.3	75.7	50.1	—28.5	January, 1892, rest.
3259	1896	do	Horse No. 3	491	do	30	93.5	70.0	55.9	—32.4	June, 1891, rest.
3260	1896	do	do		4,500 gm. "maize cake," 3,629 gm. oat straw.	31	98.1	87.9	59.6	—49.4	July, 1891, walking.
3261	1896	do	do		5,500 gm. "maize cake," 3,371 gm. oat straw.	31	115.9	91.2	52.9	—28.2	August, 1891, work, walking.
3262	1886	do	do		4,000 gm. "maize cake," 3,933 gm. oat straw.	30	91.8	77.7	51.4	—37.3	September, 1891, rest.
3263	1896	do	do		5,500 gm. "maize cake," 3,258 gm. oat straw.	31	121.7	89.2	50.8	—18.3	October, 1891, trotting.
3264	1896	do	do		6,500 gm. "maize cake," 2,600 gm. oat straw.	30	157.7	119.8	61.9	—24.0	November, 1891, work, trotting.
3265	1896	do	do		4,000 gm. "maize cake," 4,000 gm. oat straw.	31	94.5	79.2	49.6	—34.3	December, 1891, rest.
3266	1896	do	do		do	31	99.5	68.5	47.9	—16.9	January, 1892. rest.
3267	1896	do	do		do	29	87.7	77.7	58.7	—48.7	February, 1892, rest.

No. 3069. Ann. Chim. et Phys., 71, p. 136. Nos. 3070, 3071. Landw. Vers. Stat., 7, p. 413. Nos. 3072–3075. Ibid., 8, p. 99. Nos. 3076–3080. Landw. Jahrb., 8, p. 706; 8 Sup. I, p. 77. Nos. 3081–3101. Études expérimentales sur l'alimentation du cheval de trait, 1883, p. 167. Nos. 3102–3119. Études expérimentales sur l'alimentation du cheval de trait, 1887, p. 96. No. 3120. Jahresber. Agr. Chem., 30, p. 567. No. 3121. Ibid., p. 569. Nos. 3122, 3123. Ibid., p. 571. Nos. 3124, 3125. Ibid., pp. 572, 573. No. 3126. Ibid., p. 577. Nos. 3127, 3128. Ibid., p. 578. No. 3129. Ibid., p. 581. No. 3130. Ibid., p. 583. Nos. 3131, 3132. Ibid., p. 593. Nos. 3133, 3134. Ibid., pp. 595, 596. Nos. 3135, 3136. Ibid., p. 597. Nos. 3137, 3138. Ibid., p. 601. Nos. 3139–3141. Ibid., p. 603. No. 3142. Ibid., p. 608. No. 3143. Ibid., p. 610. Nos. 3144–3155. Études expérimentales sur l'alimentation du cheval de trait, 1889, p. 46. Nos. 3156–3181. Ibid., p. 102. Nos. 3182–3199. Ann. Sci. Agron., 1892, I, pp. 42, 47–52, 78. Nos. 3200–3217. Ibid., pp. 124, 128–133, 157. Nos. 3218–3241. Ann. Sci. Agron., 1893, I, pp. 42, 46–55, 81. Nos. 3242–3267. Ann. Sci. Agron., 1896, II, pp. 153, 157–166, 193.

No. 3069 was made by Boussingault in 1838. The object was to compare the food and excretory products of a horse on a maintenance ration to see whether nitrogen was assimilated from the air. The food consisted of hay and oats Elementary analyses of food, urine, and feces were made. The conclusion was reached that nitrogen was not assimilated from the air and that some nitrogen was excreted in the gaseous excretory products.

Nos. 3070, 3071 were made by Hofmeister at the experiment station of the Royal Veterinary College in Dresden in 1864. The object was to study the digestibility of crude fiber. The subject was a horse between 7 and 8 years old. The food consisted of hay, oats, and straw. The water, dry matter, protein, fat, ash, crude fiber, and nitrogen-free extract in the food and feces and the reaction, specific gravity, water, dry matter, ash, urea, sulphuric acid, and nitrogen in the urine were determined.

The conclusion was reached that crude fiber was digested by a horse. Other conclusions regarding digestibility of protein, etc., were drawn.

Nos. 3072–3075 were made by Hofmeister at the experiment station of the Royal Veterinary College of Dresden in 1865 in connection with a series of feeding experiments. The subject was a horse. The food consisted of hay, with oats and straw in two cases. Full analyses of food, urine, and feces were made.

The principal conclusions drawn concerned digestibility, and are therefore not quoted here.

It was observed that the amount of hippuric acid in the urine increased or decreased with the increase or decrease in the amount of crude fiber digestion, when hay only or hay and oats were fed.

Nos. 3076–3080 were made by Kellner and his associates at the agricultural experiment station in Hohenheim in 1877.[1] The object was to investigate the influence of muscular exertion upon the metabolism of matter in the horse. The subject was a horse weighing about 534 kilograms. He was fed a ration of meadow hay, oats, and chopped straw. Analyses were made of the food, urine, and feces. The work done was measured by a specially constructed horse dynamometer. The work varied in amount in the different periods.

The following conclusions were reached: The amount of work done had no influence upon the total digestibility of the food or the digestibility of the different nutrients. Increased work and increased cleavage of protein go hand in hand. The cleavage of protein decreased materially as soon as the muscular exertion was diminished. Muscular exertion, under certain circumstances, can increase directly the metabolism of protein in the organism. The energy from the breaking down of organic body substance in general is to be regarded as the source of muscular power. The energy liberated by the oxidation of the nitrogen-free materials, carbohydrates, and fat, in addition to that furnished by the breaking down of the circulating protein, is that first used for mechanical energy. Protein of tissue (*organizirte Eiweiss*) will not be broken down as long as there is a sufficiency of other material which can be oxidized.

Nos. 3081–3101. These experiments and Nos. 3102–3119, 3144–3181, and 3182–3267 were made by Grandeau, associated with Le Clerc, Ballacey, and Alekan, from 1880 to 1892,[2] in connection with an investigation of the principles of horse feeding carried on for the Compagnie Générale de Voitures of Paris. This is one of the most extended investigations of the kind that has been made. In every case the digestibility of the ration as well as its value for the production of work was studied.

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[1] The portion of the work relating to the digestibility of the rations was published in connection with other similar work in a separate article by Wolff, Funke, Kreuzhage, and Kellner. Landw. Jahrb., 8 (1879), Sup. I, p. 6.

[2] The report of the experiments made from 1880 to 1887 was first published in "Études Expérimentales sur l'alimentation du Cheval de Trait," and also in Ann. Sci. Agron., 1884, II; 1885, I; 1886, II; and 1888, II.

There were seven series of experiments. In the first (Nos. 3081–3101) a mixed ration consisting of "maize cake," horse beans, maize, oats, hay, and straw was fed. The maize cake was made from starch factory and distillery waste, and contained a considerable portion of potato and barley as well as corn refuse. In the second series (Nos. 3102–3119) the ration consisted of hay; in the third series (Nos. 3144–3155), of oats and straw; in the fourth series (Nos. 3156–3181), of hay and straw; in the fifth series (Nos. 3182–3217), of maize and straw; in the sixth series (Nos. 3218–3241), of horse beans and oat straw; and in the seventh series (Nos. 3242–3267), of maize cake and oat straw.

Analyses were made of the food, urine, and feces. In most cases the nitrogen volatilized from the feces while drying, that eliminated in the perspiration and in the material removed by currying, and that from the hoofs, is taken into account. In inserting the experiments in the present compilation the nitrogen from these sources was included with that of the feces.

The effect of the rations was studied while the horses were at rest, walking, trotting, at work while walking, and at work while trotting. The work consisted in turning the arm of a dynamometer a definite number of times. Experiments were also made in which the horses drew a vehicle, though the metabolism of nitrogen was not always studied in this connection. The effect of the rations under the different conditions of rest and work on temperature and weight of the animals was studied. In every case the detailed results for each horse for each day of the various periods are given in tabular form.

The conclusions drawn have to do particularly with the problem of feeding horses.[1]

Following are some of the principal conclusions drawn from these experiments:

The pace at which a horse travels was found to have a marked influence on the amount of labor performed and the food required. Thus, a horse walking 7.8 kilometers per day neither gained nor lost in weight on a daily ration of 8,800 grams of hay, while a ration of 10,886 grams was not sufficient provided the horse trotted the same distance. When a horse walked the above distance and drew a load, the additional work being equivolent to 60,449 kilogram meters, a ration of 11,975 grams of hay was sufficient for maintenance. A ration of 14,787 grams, all a horse would consume, was not sufficient for maintenance when the same work was done trotting. Some of the reasons given for the fact that rapid work is less economical than slow work are the increased action of the heart when a horse is trotting or galloping; the lifting of his own weight at each step only to allow it to fall again, thus developing heat; and the increase of body temperature with exertion and the loss of heat by evaporation through the skin and lungs.

A horse of 500 kilograms weight by the motion of forward progression through a horizontal distance of 10 kilometers at a speed of 1.5 meters per second loses 2.4 kilograms in weight. A horse of the same weight covering a distance of 10 kilometers with a velocity of 1.5 meters per second, and producing 190,000 kilogram-meters of work loses about 3.8 kilograms in weight.

Generally speaking, the horses digested from a ration of maize cake (1) sometimes more and sometimes less carbohydrates, but always two or three times as much protein as from a ration of hay; (2) less carbohydrates, but more protein than from a ration of oats or maize, and (3) less carbohydrates and protein than from a ration of horse beans.

In general, when no work was performed, the horses gained in weight when oats were consumed, but the gain was not proportional to the quantity eaten. The gain was less with hay, and hay furnished less available energy. On the other hand, maize cake did not produce a gain comparable with that from maize and beans. When walking the gains in weight of the horses varied with the different rations, being greatest when maize was fed, followed by beans, maize cake, oats, and hay in

[1] For a summary of a number of the earlier experiments see Experiment Station Record, 6, p. 1018.

the order mentioned. The superiority of cake to oats is still more noticeable when it is remembered that the quantities assimilated of the former are much less than the latter. On the same basis the apparent superiority of the maize, especially of beans, diminishes. As a ration for horses when trotting, hay was much inferior to the other feeding stuffs as regards gains in weight, and it can also be said that the nutritive ingredients assimilated from this food are much inferior in quality. Maize cake produced less satisfactory results than beans, and maize than oats, as regards the available energy furnished. For work done in drawing a cab maize at first seemed to be inferior to the other rations, but this was not the case. The quantity fed did not furnish a sufficient amount of nutriment, which was also true of the oats, cake, and beans. From these experiments it appeared that maize cake was much superior both to hay, a coarse fodder, and to beans, which may be regarded as a type of feeding stuffs rich in protein. On the other hand, the cake was much inferior to feeding stuffs like maize and oats, which are rich in starch and moderately rich in protein. Its coefficient of digestibility is also midway between maize and oats, as is also its nutritive ratio.

Nos. 3102–3119. (See Nos. 3081–3101.)

Nos. 3120–3143[1] were made by Wolff and his associates at Hohenheim in 1885–86. The objects were to investigate the capacity for work of a horse on a diet rich in nitrogen and one containing little nitrogen, and to study the metabolism of nitrogen and mineral matter. The basal ration consisted of meadow hay, usually with oats. In some cases straw, beans, flaxseed, or maize were also fed. The dry matter, organic substance, protein, fat, crude fiber, and nitrogen-free extract in food and feces and the nitrogen in the urine were determined. In addition the dry matter, ash, sodium, potassium, calcium and magnesium oxids, the phosphoric, sulphuric, and salicylic acids, iron oxid, and chlorin in the food, urine, and feces (in one case food and feces only) were determined in a number of the experiments. The muscular work performed was measured by a dynamometer of special construction.

The principal conclusions drawn were the following: The food rich in nitrogen had no greater nutritive value as regards the production of energy than that containing little nitrogen. Digestible protein beyond a certain definite minimum has no more value for the production of energy than an equal quantity by weight of starch or the equivalent quantity of fat. The amounts of nitrogen, the total ash, and the several mineral constituents excreted in the urine and feces were equal to the amount consumed. This is a proof that during the whole time of the experiment the subject remained in equilibrium; that is, the food consumed was just sufficient for the amount of work performed under the experimental conditions. A horse weighing 500 kilograms requires for maintenance in medium condition when no external work is performed, 4,200 grams of nutrients per day, it being assumed that a considerable quantity (at least half the daily ration) consists of coarse fodder.

Nos. 3144–3267. (See Nos. 3081–3101.)

EXPERIMENTS WITH RABBITS.

INFLUENCE OF OTHER CONDITIONS THAN FEEDING.

In Table 34 are included 22 tests with rabbits. All the animals were in health. The special questions investigated are noted in the text accompanying the table.

[1] These experiments were originally published in Landw. Jahrb., 16, 1887, Sup. III, p. 1. The figures are more conveniently arranged in the publication cited in Table 33.

TABLE 34.—*Experiments with rabbits. Influence of other conditions than feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm*	*Gm.*	
3268	1881	Rubner	Rabbit		Fasting	7	0.0	0.8	0.0	—0.8	
3269	1881	do	do		do	9	0.0	2.2	0.0	—2.2	
3270	1881	do	do		do	19	0.0	1.3	0.0	—1.3	
3271	1881	do	do		do	19	0.0	0.8	0.0	—0.8	
3272	1888	Reprev	Rabbit No. 1	1–2	60 gm. oats, 206 gm. grass. 59 gm. water	2	2.4	1.2	0.7	+0.5	Sexual rest.
3273	1888	do	do		65 gm. oats, 187 gm. grass, 43 gm. water	27	2.5	1.1	0.4	+1.0	Fifth day after pairing to third day before delivery. Nitrogen in feces 26 days only.
3274	1888	do	do		91 gm. oats, 162 gm. grass, 53 gm. water	1	2.7	0.9	(0.4)	+1.4	First day of No. 3273.
3275	1888	do	do		43 gm. oats, 148 gm. grass, 42 gm. water	2	1.7	0.5	0.3	+0.9	Last 2 days of No. 3273.
3276	1888	do	do		59 gm. oats, 190 gm. grass, 31 gm. water	27	2.0	0.9	0.5	+0.6	Pregnancy.
3277	1888	do	do		75 gm. oats, 226 gm. grass, 32 gm. water	2	2.7	0.8	0.5	+1.4	First 2 days of No. 3276.
3278	1888	do	do		22 gm. oats, 234 gm. grass, 24 gm. water	1	1.8	0.6	0.4	+0.8	Last day of No. 3276.
3279	1888	do	do		64 gm. oats, 127 gm. grass, 41 gm. water	6	1.9	0.9	0.8	+0.2	Sexual rest.
3280	1888	do	do		72 gm. oats, 110 gm. grass, 55 gm. water	28	2.0	0.7	0.6	+0.7	Pregnancy.
3281	1888	do	do		98 gm. oats, 175 gm. grass, 26 gm. water	2	2.7	1.0	0.6	+1.1	First 2 days of No. 3280.
3282	1888	do	do		56 gm. oats, 89 gm. grass, 92 gm. water	2	1.5	0.6	0.3	+0.6	Last 2 days of No. 3280.
3283	1888	do	Large rabbit	2	46 gm. oats, 82 gm. grass, 74 gm. water	4	1.5	1.0	(0.4)	+0.1	Before pregnancy.
3284	1888	do	do		44 gm. oats, 116 gm. grass, 100 gm. water	24	1.7	0.9	0.4	+0.4	Pregnancy. Nitrogen in feces, mean of 18 days. (One day in middle of period, food ad libitum, not taken into account.)
3285	1888	do	do		60 gm. oats, 108 gm. grass, 125 gm. water	2	1.8	1.4	(0.4)	0.0	First 2 days of No. 3284.
3286	1888	do	do		24 gm. oats, 199 gm. grass, 102 gm. water	2	1.4	0.6	0.3	+0.5	Last 2 days of No. 3284.
3287	1888	do	do		94 gm. oats, 122 gm. grass, 130 gm. water	8	2.6	0.8	0.8	+1.0	After pregnancy. (Sexual rest.)
3288	1892	Graffenberger	Rabbit	3.7	110 gm. oats	11	1.6	1.1	0.2	+0.3	Subject was kept in the light and was given 1 gm. calcium carbonate.
3289	1892	do	Rabbit	3.5	do	11	1.6	1.1	0.2	+0.3	Subject was kept in the dark and was given 1 gm. calcium carbonate.

No. 3268. *Ztschr. Biol.* 17, p. 218. Nos. 3269–3271. Ibid., p. 219. Nos. 3272–3275. On the influence of pregnancy on the metabolism of matter in animals. Inaug. Diss. (Russian), St. Petersburg, 1888, p. 22. Nos. 3276–3278. Ibid., p. 34. Nos. 3279–3282. Ibid., p. 44. Nos. 3283–3287. Ibid., p. 68. Nos. 3288, 3289. Pflüger's Arch. Physiol., 53, pp. 247–248.

Nos. 3268–3271 were made by Rubner at the laboratory of the Physiological Institute at Munich in 1879–80. The object was to investigate the amount of material, i. e., body tissue, metabolized by fasting Herbivora. The subject was a rabbit. The nitrogen in the urine was determined. In a number of experiments the carbon dioxid excreted was also measured with Voit's small respiration apparatus.

Though the balance of income and outgo of carbon was not determined, the conclusion was reached that Herbivora, when fasting, metabolize almost as much protein as Carnivora of the same weight.

Nos. 3272–3287. (See Nos. 2970–2972, Table 29.)

Nos. 3288, 3289 were made by Graffenberger at the Institute of Animal Physiology at the University of Breslau in 1892. The object was to note the changes which take place in the animal organism when the subject is kept in the dark. The subjects were 2 rabbits. The food consisted of oats to which a little calcium carbonate was added. The food, urine, and feces were analyzed. The blood was also examined from time to time, and at the close of the experiments the animals were killed and the blood and organs examined. One rabbit was kept in the light and the other in the dark.

From these experiments and a preliminary experiment not recorded in the present compilation the conclusion was reached that animals kept in the dark gain in weight more rapidly than those kept in the light. Further, light had no particular influence on metabolism or gain in nitrogen. An increase in metabolism as a whole seems to have very little if any connection with the increased excretion of carbon dioxid, which was observed by some investigators.[1] The two rabbits digested their food equally well. Light appeared to have no particular influence on the formation of glycogen. The subject kept in the dark gained more fat than the one kept in the light; the gain in fat was less after a time, probably owing to the fact that the general health became affected.

Tests were made by Aronsohn and Sachs[2] to study the relation of the brain to body temperature and to fever. Three rabbits and a dog were used as subjects. The experiments with the dog are noted on page 345.

The brain of the animals was pierced with a needle through the eye or through an opening made in the skull. This caused an increased body temperature. During the operation the third rabbit was given morphin. The rabbits consumed daily 20 grams of starch, 5 grams of sugar, and 0.1 gram of a mixture of several salts approximating hay ash in composition. The food contained no nitrogen. Before the operation the rabbits excreted daily, on an average, 1.1, 1.7, and 0.3 grams of nitrogen. After the operation, while the temperature was higher than normal, the daily excretion was 1.4, 2.1, and 0.3 grams. After the temperature again became normal rabbits 1 and 2 excreted 1.0 and 0.6 grams. On the same diet rabbit 2 excreted 1.1 grams of nitrogen daily during fever from other cause than injury to the brain, while the excretion under normal conditions was 0.6.

The conclusions drawn from these experiments will be found on page 345.

EXPERIMENTS WITH SHEEP.

INFLUENCE OF FEEDING.

In Table 35 are included 104 tests with sheep. All the animals were in health. The nitrogen balance was usually determined in connection with feeding and digestion experiments. In some cases special questions were investigated, which are noted in the text accompanying the table.

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[1] Moleschott, Wiener med. Wochenschr., No. 43 (1855).

[2] Pflüger's Arch., 37 (1885), p. 232.

TABLE 35.—*Experiments with sheep. Influence of feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3290	1863	Reiset	Sheep		Beets, beans, oats, wheat straw	168	9.1	2.5		+6.6	
3291	1864	Hofmeister	Sheep		1,000 gm. meadow hay, 750 gm. oats		25.0	7.5	10.0	+7.5	
3292	1864	do	do		842.5 gm. meadow hay, 750 gm. oats, 35 gm. oil		22.5	10.0	7.5	+5.0	
3293	1864	do	do		762.5 gm. meadow hay, 750 gm. oats. 75 gm. oil		22.5	12.5	7.5	+2.5	
3294	1864	do	do		610 gm. meadow hay, 750 gm. oats, 67.5 gm. oil		20.0	10.0	7.5	+2.5	
3295	1864	do	do		1,000 gm. meadow hay, 352.5 rape-seed cake		30.0	15.0	7.5	+7.5	
3296	1864	do	do		967.5 gm. meadow hay, 260 gm. rape-seed cake, 17.5 gm. oil.		25.0	12.5	7.5	+5.0	
3297	1864	do	do		940 gm. meadow hay, 225 gm. rape-seed cake, 16.5 gm. oil.		22.5	12.5	7.5	+2.5	
3298	1865	Hellriegel and Lucanus.	Sheep I		1,087 gm. hay, 1,544 gm. water	14	17.9	9.6	7.9	+0.4	
3299	1865	do	do		472 gm. chopped straw, 395 gm. water	4	3.3	3.8	2.4	—2.9	
3300	1865	do	do		1,488 gm. fermented chopped straw	5	3.9	2.9	3.0	—2.0	
3301	1865	do	do		1,616 gm. chopped straw, steeped	6	4.4	2.6	3.2	—1.4	
3302	1865	do	do		381 gm. chopped straw, 1,440 gm. turnips	8	5.3	3.0	2.9	—0.6	
3303	1865	do	Sheep II		1,066 gm. hay, 1,424 gm. water	14	15.1	7.5	6.5	+1.1	
3304	1865	do	do		637 gm. chopped straw, 558 gm. water	5	4.4	2.8	3.5	—1.9	
3305	1865	do	do		1,731 gm. fermented chopped straw	5	4.6	3.0	3.6	—2.0	
3306	1865	do	do		1,908 gm. chopped straw, steeped	6	5.2	3.2	3.7	—1.7	
3307	1865	do	do		777 gm. chopped straw, 150 gm. lupine seed, 880 gm. water.	5	13.2	8.1	4.3	+0.8	
3308	1865	do	do		717 gm. chopped straw, 350 gm. lupine seed, 1,177 cc. water.	6	23.3	15.4	4.6	+3.3	
3309	1868	Hofmeister	Sheep		250 gm. hay, 512.5 gm. oat straw	3–4	6.8	2.4	3.6	+0.8	
3310	1868	do	do		250 gm. hay, 500 gm. straw, 17.5 gm. rape-seed cake.	3–4	7.3	3.0	4.4	—0.1	
3311	1868	do	do		250 gm. hay, 442.5 gm. straw, 33.5 gm. rape-seed cake.	3–4	7.0	3.7	4.0	—0.7	
3312	1868	do	do		250 gm. hay, 457.5 gm. straw, 67.5 gm. rape-seed cake.	3–4	8.8	2.8	4.8	+1.2	
3313	1868	do	do		250 gm. hay, 487.5 gm. straw, 840 gm. potatoes	3–4	8.4	2.1	6.3	0.0	
3314	1868	do	do		250 gm. hay, 397.5 gm. straw, 2,000 gm. potatoes.	3–4	13.0	2.0	6.6	+4.4	
3315	1868	do	do		250 gm. hay, 385 gm. straw, 3,000 gm. potatoes.	3–4	16.8	2.4	9.2	+5.2	
3316	1868	do	do		250 gm. hay, 390 gm. straw, 3,950 gm. potatoes.	3–4	19.2	2.4	9.6	+7.2	

3317	1868	....do	....do	....	250 gm hay, 367.5 gm. straw, 3,900 gm. potatoes, 33.5 gm. rape-seed cake.	3–4	20.4	2.4	11.6	+6.4	
3318	1868	....do	....do	....	250 gm. hay, 282.5 gm. straw, 3,457.5 gm. potatoes, 33.5 gm. rape-seed cake.	3–4	18.4	3.2	9.6	+5.6	
3319	1868	....do	....do	....	250 gm. hay, 197.5 gm. straw, 3,840 gm. potatoes, 33.5 gm. rape-seed cake.	3–4	19.8	2.9	(9.6)	+7.3	The nitrogen in feces was supplied from No. 3318.
3320	1868	....do	....do	....	250 gm. hay, 495 gm. straw, 1,000 gm. mangel-wurzels.	3–4	8.0	3.7	6.4	—2.1	
3321	1868	....do	....do	....	250 gm. hay, 215 gm. straw, 1,970 gm. mangel-wurzels.	3–4	8.2	3.9	6.4	—2.1	
3322	1868	....do	....do	....	250 gm. hay, 235 gm. straw, 2,485 gm. mangel-wurzels, 33.5 rape-seed cake.	3–4	10.9	5.0	6.4	—0.5	
3323	1868	....do	....do	....	250 gm. hay, 575 gm. straw, 37.5 gm. rye bran.	3–4	15.2	6.4	9.4	—0.6	
3324	1868	....do	....do	....	250 gm. hay, 537.5 gm. straw, 375 gm. rye bran, 35 gm. oil.	3–4	15.0	7.8	7.2	0.0	
3325	1868	....do	....do	....	250 gm. hay, 332.5 gm. straw, 375 gm. rye bran, 50 gm. oil.	3–4	13.9	7.4	7.6	—1.1	
3326	1868	....do	....do	....	250 gm. hay, 125 gm. straw, 345 gm. rye bran, 61.5 gm. oil.	3.4	12.0	6.8	6.4	—1.2	
3327	1868	....do	....do	....	1,460 gm. meadow hay	......	17.5	7.5	7.5	+2.5	
3328	1868	....do	....do	....	1,347.5 gm. meadow hay, 250 gm. oats	......	17.5	......	7.5	......	
3329	1868	....do	....do	....	1,137.5 gm. meadow hay, 500 gm. oats	......	22.5	12.5	7.5	+2.5	
3330	1869	....do	Sheep I (Merino)	....	167 gm. rape-seed cake, 1,000 gm. potatoes, 1,000 gm. meadow hay.	......	25.0	11.5	12.5	+1.0	
3331	1869	....do	Sheep II (South-down-Frank).	....	167 gm. rape-seed cake, 1,000 gm. potatoes, 992 gm. meadow hay.	......	25.0	11.2	10.8	+3.0	
3332	1869	....do	Sheep I	....	163 gm. rape-seed cake, 1,667 gm. potatoes, 803 gm. meadow hay.	......	24.2	11.7	11.2	+1.3	
3333	1869	....do	Sheep II	....	167 gm. rape seed cake, 1,667 gm. potatoes, 813 gm. meadow hay.	......	24.7	11.7	11.7	+1.3	
3334	1869	....do	Sheep I	....	138 gm. rape-seed cake, 125 gm. peas, 1,667 gm. potatoes, 633 gm. meadow hay.	......	24.8	15.7	11.2	—2.1	
3335	1869	....do	Sheep II	....	152 gm. rape-seed cake, 125 gm. peas, 1,667 gm. potatoes, 657 gm. meadow hay.	......	25.8	14.7	10.7	+0.4	
3336	1869	....do	Sheep I	....	138 gm. rape-seed cake, 125 gm. peas, 1,667 gm. potatoes, 645 gm. meadow hay.	......	25.2	10.7	11.3	+3.2	
3337	1869	....do	Sheep II	....	163 gm. rape-seed cake, 125 gm. peas, 1,667 gm. potatoes, 667 gm. meadow hay.	......	26.7	14.0	10.2	+2.5	
3338	1870	Schulze and Märcker and associates.	Sheep I and II (average).	54.5	915 gm. meadow hay, 337 gm. barley meal, 6 gm. salt.	8	18.9	8.8	7.3	+2.8	
3339	1870	.... do	....do	55.5	923 gm. meadow hay, 343.5 gm. oatmeal, 6 gm. salt.	8	18.8	9.0	7.9	+1.9	
3340	1870	....do	....do	56.0	659 gm. meadow hay, 693 gm. oatmeal, 6 gm. salt.	9	19.2	8.8	8.4	+2.0	
3341	1870	....do	....do	57,0	1,111 gm. meadow hay, 6 gm. salt	10	16.3	9.4	7.2	—0.3	
3342	1870	....do	Sheep III and IV (average).	48.6	1,011 gm. meadow hay, 6 gm. salt	10	14.8	8.0	6.5	+0.3	
3343	1870	....do	Sheep I and IV (average).	50.4	918 gm. meadow hay, 105.5 starch waste, 2.3 gm. salt.	13	16.0	9.4	6.6	0.0	
3344	1870	....do	Sheep II and III (average).	56.0	998 gm. meadow hay, 131.5 gm. gluten, 6 gm. salt.	10	29.0	22.2	6.5	+0.3	

TABLE 35.—*Experiments with sheep. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3345	1870	Schulze and Märcker and associates.	Sheep II	67.2	1,029 gm. meadow hay, 290 gm. gluten, 6 gm. salt.	10	46.9	38.0	7.2	+1.7	
3346	1870	....do	....do	63.4	1,197 gm. meadow hay, 6 gm. salt	10	16.7	9.9	7.5	—0.7	
3347	1870	....do	Sheep III	52.2	960 gm. meadow hay, 6 gm. salt	10	13.3	8.1	5.5	—0.3	
3348	1870	....do	Sheep II	64.1	1,227 gm. rowen, 6 gm. salt	10	25.4	16.4	8.1	+0.9	
3349	1870	....do	Sheep III	52.3	949 gm. rowen, 6 gm. salt	10	19.5	12.9	6.2	+0.4	
3350	1870	....do	....do	....	1,500 gm. meadow hay, 6 gm. salt	22	17.8	7.9	8.3	+1.6	
3351	1870	....do	Sheep IV	....	....do	22	17.7	7.3	8.2	+2.2	
3352	1870	....do	Sheep I	50.5	1,080 gm. meadow hay, 6 gm. salt	18	17.3	7.5	7.7	+2.1	
3353	1870	....do	Sheep II	56.4	1,272 gm. meadow hay, 6 gm. salt	18	20.1	8.4	9.0	+2.7	
3354	1870	....do	Sheep III and IV (average).	48.7	921 gm. meadow hay, 289.5 gm. starch, 25 gm. sugar.	11	14.4	3.9	9.5	+1.0	Subject was given 32.5 gm. disodium phosphate and 10.5 gm. potassium chlorid.
3355	1870	....do	....do	49.4	902 gm. meadow hay, 342.5 gm. bean meal, 6 gm. salt.	8	26.4	15.4	7.7	+3.3	
3356	1870	....do	....do	50.1	689 gm. meadow hay, 336 gm. bean meal, 295 gm. starch, 29 gm. sugar.	8	24.3	10.2	10.5	+3.6	Subject was given 31 gm. disodium phosphate and 10 gm. potassium chlorid.
3357	1870	....do	Sheep III	49.4	564 gm. meadow hay, 637 gm. bean meal, 6 gm. salt.	9	33.5	22.8	8.4	+2.3	
3358	1875	Weiske, Schrodt, Pott, and Kellner.	Sheep I	....	1,000 gm. meadow hay, 250 gm. barley meal, 5 gm. salt.	7	21.2	10.5	8.7	+2.0	Sheep unshorn.
3359	1875	....do	Sheep II	....	....do	7	21.2	10.8	8.1	+2.3	Do.
3360	1875	....do	Sheep I	....	....do	13	21.2	11.7	8.5	+1.0	Sheep after shearing.
3361	1875	....do	Sheep II	....	....do	13	21.2	11.7	8.4	+1.1	Do.
3362	1876	Weiske, Kellner, Schrodt, and Wimmer.	Sheep I	44	763.3 gm. hay, 200 gm. oatmeal, 5 gm. salt	6	16.0	9.5	5.5	+1.0	
3363	1876	....do	Sheep II	49	792.6 gm. hay, 200 gm. oatmeal, 5 gm. salt	6	16.4	10.2	5.2	+1.0	
3364	1876	....do	Sheep I	44	775.3 gm. hay, 100 gm. oatmeal, 20 gm. fish scrap, 5 gm. salt.	8	16.1	10.4	6.0	—0.3	

3365	1876	.....do	Sheep II	49	800 gm. hay, 100 gm. oatmeal, 20 gm. fish scrap, 5 gm. salt.	8	16.5	10.7	5.7	+0.1	
3366	1876	.....do	Sheep I	44	400 gm. hay, 100 gm. oatmeal, 371.5 gm. straw, 65.2 gm. fish scrap.	8	16.3	9.7	5.4	+1.2	
3367	1876	.....do	.....do	44	600 gm. straw, 1,000 gm. mangel-wurzels, 131.9 gm. fish scrap.	8	16.4	10.0	4.9	+1.5	
3368	1876	.....do	Sheep II	49	.....do	8	16.4	9.3	5.1	+2.0	
3369	1879	Weiske, Kennophol, and Schulze.	Sheep I	59	987 gm. meadow hay	8	19.8	12.0	7.0	+0.8	
3370	1879	.....do	Sheep II	62	1,000 gm. meadow hay	8	20.1	13.0	7.0	+0.1	
3371	1879	.....do	Sheep I	59	500 gm. meadow hay, 316 gm. extracted hops.	8	18.0	8.6	9.4	0.0	
3372	1879	.....do	Sheep II	62	500 gm. meadow hay, 379 gm. extracted hops.	8	19.6	9.0	10.7	—0.1	
3373	1880	Kellner	Sheep		250 gm. lupine seed (bitter principle removed), 750 gm. hay.	8	24.3	15.9	6.0	+2.4	
3374	1880	.....do	.....do		250 gm. lupine seed (steamed), 750 gm. hay.	8	25.4	17.2	6.2	+2.0	
3375	1882	Weiske, Kennophol, and Schulze.	Sheep (Rambouillet.)		1,000 gm. meadow hay, 256 gm. barley, 125 gm. beans, 8 gm. salt.	8	28.9	16.0	9.0	+3.9	
3376	1882	.....do	Sheep (Southdown-Merino).		.....do	8	28.9	16.6	9.4	+2.9	
3377	1885	Jordan	Sheep		600 gm. timothy hay, 200 gm. cotton-seed meal.	5	20.7	16.8	5.4	—1.5	P_2O_5 in food, 8.1 gm.; in urine, 0.0 gm.; in feces, 7.5 gm.; gain, 0.6 gm. K_2O in food, 12.4 gm.; in urine, 5.2 gm.; in feces, 6.1 gm.; gain, 1.1 gm.
3378	1885	.....do	.....do		600 gm. timothy hay, 200 gm. corn meal	4	9.0	4.6	4.1	+0.3	P_2O_5 in food, 2.7 gm.; in urine, 0.0 gm.; in feces, 2.5 gm.; gain, 0.2 gm. K_2O in food, 8.2 gm.; in urine, 2.7 gm.; in feces, 3.0 gm.; gain, 2.5 gm.
3379	1886	Weiske, Schulze, and Flechsig.	Sheep		500 gm. bean meal, 6 gm. salt	7	22.6	20.9	2.1	—0.4	
3380	1886	.....do	.....do		490 gm. bean meal, 515 gm. chopped oat straw, 6 gm. salt.	6	24.8	16.8	5.2	+2.8	
3381	1886	.....do	.....do		500 gm. bean meal, 180 gm. starch, 20 gm. sugar, 6 gm. salt.	5	22.8	14.9	2.7	+5.2	
3382	1886	.....do	.....do		490 gm. bean meal, 515 gm. oat straw, 6 gm. salt.	5	24.9	17.3	6.1	+1.5	
3383	1886	.....do	.....do		500 gm. bean meal, 90 gm. starch, 10 gm. sugar, 6 gm. salt.	5	22.7	17.8	2.1	+2.8	
3384	1895	Wicke and Weiske	Sheep I	44.8	800 gm. hay, 150 gm. clover, 3,566 cc. water	7	15.0	8.3	5.6	+1.1	
3385	1895	.....do	Sheep II	38.5	700 gm. hay, 135 gm. clover, 1,838 cc. water	7	13.2	7.6	4.8	+0.8	
3386	1895	.....do	Sheep I	44.8	800 gm. hay, 150 gm. clover, 60 gm. olive oil, 4,205 cc. water.	9	15.0	6.9	5.7	+2.4	
3387	1895	.....do	Sheep II	38.5	700 gm. hay, 135 gm. clover, 148 gm. starch, 2,239 cc. water.	9	13.2	5.7	6.2	+1.3	
3388	1895	.....do	Sheep I	44.8	800 gm. hay, 150 gm. clover, 174 gm. starch, 3,793 cc. water.	9	15.0	6.1	6.3	+2.6	
3389	1895	.....do	Sheep II	38.5	700 gm. hay, 135 gm. clover, 50 gm. olive oil, 2,140 cc. water.	9	13.2	6.1	5.1	+2.0	
3390	1895	.....do	Sheep I	52	800 gm. hay, 200 gm. flaxseed, 1,926 cc. water	8	22.0	15.2	5.9	+0.9	
3391	1895	.....do	.....do	52	800 gm. hay, 200 gm. flaxseed, 174 gm. starch, 1,946 cc. water.	9	22.0	13.6	6.8	+1.6	

TABLE 35.—*Experiments with sheep. Influence of feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3392	1895	Wicke and Weiske	Sheep I	52	800 gm. hay, 200 gm. flaxseed, 60 gm. olive oil, 2,136 cc. water.	9	22.0	14.8	6.3	+0.9	
3393	1895	.....do	Sheep II	41	650 gm. hay, 200 flaxseed, 1,265 cc. water	8	19.4	13.1	5.5	+0.8	
3394	1895	.....do	.....do	41	650 gm. hay, 200 gm. flaxseed, 50 gm. olive oil, 1,252 cc. water.	9	19.4	12.6	5.4	+1.4	

No. 3290. Compt. Rend., 56, p. 574. No. 3291. Landw. Vers. Stat., 6, p. 302. Nos. 3292–3295. Ibid., p. 303. Nos. 3296, 3297. Ibid., p. 304. Nos. 3298–3308. Landw. Vers. Stat., 7, pp. 391–396. No. 3309. Landw. Vers. Stat., 10, p. 284. No. 3310. Ibid., p. 286. No. 3311. Ibid., p. 288. No. 3312. Ibid., p. 293. No. 3313. Ibid., p. 308. No. 3314. Ibid., p. 310. Nos. 3315, 3316. Ibid., pp. 312, 313. Nos. 3317–3319. Ibid., pp. 315–317. No. 3320. Landw. Vers. Stat., 11, p. 242. No. 3321. Ibid., p. 244. No. 3322. Ibid., p. 246. No. 3323. Ibid., p. 365. Nos. 3324, 3325. Ibid., pp. 367, 368. No. 3326. Ibid., 370. Nos. 3327–3329. Landw. Vers. Stat., 6, p. 302. Nos. 3330, 3331. Landw. Vers. Stat., 12, p. 103. Nos. 3332–3336. Ibid., p. 104. No. 3337. Ibid., p. 105. Nos. 3338–3357. Jour. Landw., 1870, p. 301. Nos. 3358, 3359. Jour. Landw., 1875, p. 311. Nos. 3360, 3361. Ibid., p. 315. Nos. 3362, 3363. Jour. Landw., 1876, p. 276. Nos. 3364, 3365. Ibid., p. 278. No. 3366. Ibid., p. 284. Nos. 3367, 3368. Ibid., p. 287. Nos. 3369, 3370. Jour. Landw., 1879, p. 265. Nos. 3371, 3372. Ibid., p. 269. Nos. 3373, 3374. Landw. Jahrb., 9, p. 994. Nos. 3375, 3376. Jour. Landw., 1882, p. 404. Nos. 3377 3378. Maine Sta. Rpt., 1885–86, pp. 44, 45. No. 3379. Ztschr. Biol., 22, p. 380. No. 3380. Ibid., p. 383. No. 3381. Iibd., p. 387. No. 3382. Ibid., p. 390. No. 3383. Ibid., p. 392. Nos. 3384, 3385. Ztschr. physiol. Chem., 21, p. 55. Nos. 3386, 3387. Ibid., p. 59. Nos. 3388, 3389. Ibid., p. 65. Nos. 3390–3394. Ibid., 22, pp. 144, 145.

No. 3290 was made by Reiset in 1856–57 in connection with the study of the feeding and fattening of farm animals. The experiment was begun with three sheep, but one was dropped before the close. The average results were taken as representing the values for one animal when the figures were added to the present compilation. The experiment was divided into four periods, but the data for the individual periods are not given by the author. The food consisted of beets, bran, oats, and wheat straw. Analyses were made of the food and of the urine and feces together. At the beginning of the experiment two sheep of the same breed were slaughtered and the amounts of flesh, wool, and tallow determined. The amounts for the sheep used in this experiment were calculated from the data thus obtained. At the close of the experiment the sheep were slaughtered and the weight of the flesh and organs determined. They had gained 6 kilograms in weight, 3 kilograms of which the author calculates to be pure muscular tissue. All the nitrogen consumed was not recovered in the urine and feces, since they contained 6.6 grams per day less than the food consumed. The author calculates that the muscular tissues gained would account for 0.3 gram of nitrogen daily. Deducting this amount there would still remain 6.3 grams, which, according to the author, was not stored in the organism, but was excreted in the gaseous excretory products. The author gives 6 grams per day as the amount of nitrogen which was thus excreted by one sheep. The discrepancy between this figure and that given in the table is due to the fact that in discussing his results as a whole the author uses round numbers. In computing the daily average for the present compilation this was not done.

[Reiset's work is often quoted as a proof of the excretion of nitrogen in the gaseous excretory products. The work was carried on many years ago and the experiment is of more interest to-day from an historical standpoint than from its actual value. The bearing of this work upon the subject of the excretion of nitrogen in the excretory products has been discussed in a previous publication of this Office.[1]]

Nos. 3291–3297 were made by Hofmeister at the experiment station of the Royal Veterinary School at Dresden in 1863 in connection with a series of feeding experiments. The subjects were 2 three-year-old sheep. They were fed together and the average results were taken in determining values of food for one sheep. The rations consisted of meadow hay with oats, oats and oil, rape-seed cake, or rape-seed cake and oil.

The dry matter, water, ash, fat, crude fiber, nitrogen, and carbohydrates in fodder and feces, and the dry matter, ash, nitrogen, urea, and hippuric acid in the urine were determined. The conclusions reached are not of the kind which are quoted here.

Nos. 3298–3308 were made by Hellriegel and Lucanus at the experiment station in Dahme in 1862. The object was to investigate the nutritive value of fermented chopped straw as compared with dry and steeped chopped straw. The experiments were made with 2 sheep. Each was fed dry chopped straw, fermented straw, and steeped straw with turnips or lupine seeds. For purposes of comparison each sheep was fed hay alone for 14 days. The nitrogen in the food, urine, and feces was determined.

Fermented straw is usually prepared by moistening the chopped straw with water, mixing with potatoes and other materials, and allowing the mixture to ferment. The temperature rises to 40–45° C. In these experiments the chopped straw was fermented without the addition of potatoes or other materials. The steeped straw was prepared by pouring hot water over chopped straw and allowing it to stand.

The conclusion was reached that the sheep made better gains when steeped straw was fed, because less effort was required to chew it and they could eat larger quantities.

The coefficient of digestibility of the dry matter of the dry chopped straw was

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[1] The excretion of metabolized nitrogen by animals, C. F. Langworthy, Experiment Station Record 7, pp. 817–825.

42.1 per cent, of the steeped straw 41.8 per cent, and of the fermented straw 37.9 per cent.

Nos. 3309–3329 were made by Hofmeister and associates at the experiment station of the Royal Veterinary School in Dresden in 1864–65 in connection with a series of feeding experiments. The subjects were 2 sheep 1½ years old, weighing about 70 kilograms each. The sheep were fed together and the urine and feces were not collected for each sheep separately. The average results were taken as representing the values for 1 sheep. The basal ration consisted of hay or hay and straw. In several periods there was added either potatoes with or without rape-seed cake, mangel-wurzels with or without rape-seed cake, rye bran with or without oil, or oats.

Analyses of the feeding stuffs and of the feces were made. The specific gravity, dry matter, ash, hippuric acid, uric acid, and nitrogen in the urine were determined.

The conclusions reached do not bear directly upon the metabolism of nitrogen and are therefore not quoted here.

Nos. 3330–3337 were made by Hofmeister at the experiment station of the Royal Veterinary School in Dresden in 1869 in connection with a feeding experiment with Merino and Southdown-Frank sheep. Three sheep of each breed were used and the average taken as the values for 1 sheep. The food consisted of rape-seed cake, meadow hay, and potatoes. In several cases peas were also fed. The food, urine, and feces were analyzed. The Southdown-Frank sheep gained flesh and the Merinos lost flesh in every case. The feeding experiment is discussed at length.

Nos. 3338–3357 were made by Schulze and Märcker at the experiment station in Weende in 1868–69. The object was to determine whether Voit's theory that no nitrogen is excreted except in the solid and liquid excretory products, held good for sheep. The subjects were full-grown animals. In some cases the tests were made with 2 animals and the average results taken as representing the value for one animal. In other cases the tests were made with one animal as a subject. The basal ration consisted of meadow hay or rowen with salt. In a number of cases starch, starch and sugar, bean meal, barley meal, oatmeal, starch waste, or gluten were also fed. In Nos. 3354 and 3356 potassium chlorid and disodium phosphate were given. Great care was taken in collecting the urine and feces, and both were analyzed.

The conclusion was reached that Voit's theory was true in the case of sheep.

Nos. 3358–3361 were made by Weiske and associates at the experiment station in Proskau in 1875. The object was to investigate the influence of shearing sheep upon the digestibility of the rations and the metabolism of nitrogen. Two sheep were used as subjects. The experiments were each divided into two periods. At the end of the first period the sheep were shorn. Several days elapsed between the first and second periods. The food consisted of meadow hay and barley meal, and the same quantity was fed throughout the experiments. The food, urine, and feces were analyzed.

The conclusion was reached that shearing increased the excretion of nitrogen in the urine. The digestibility of the food was not affected by shearing.

Nos. 3362–3368 were made by Weiske and associates at the experiment station in Proskau in 1876. The object was to investigate the digestibility of animal food (fish scrap) by Herbivora. The subjects were 2 sheep. In Nos. 3362–3365 the food consisted of hay and oatmeal, to which fish scrap was added in one period, and straw and fish scrap in another period. In Nos. 3367, 3368 straw and beets with fish scrap were consumed. The nitrogen consumed was practically the same in every case. Food, urine, and feces were analyzed. The nitrogen of the animal food was well assimilated, and the author recommends adding fish scrap, meat meal, or similar food to a ration when for any reason vegetable foods containing protein are scarce.

Nos. 3369–3372 were made by Weiske, Kennophol, and Schulze at the experiment station at Proskau in 1878. The object was to investigate the digestibility and nutritive value of hops which have been used in brewing beer. The subjects were 2 sheep. The food consisted of meadow hay fed with and without hops. The food, urine, and feces were analyzed.

The conclusion was reached that although the hops were not as valuable as coarse fodder of similar composition, yet on account of their high content of protein they are worth using as a feeding stuff when easily obtainable.

Nos. 3373, 3374 were made by Kellner at the Agricultural Experiment Station at Hohenheim in 1880. The object was to study the effect of removing the bitter principle of lupine seeds upon their digestibility. The subject was a sheep. The basal ration consisted of hay; in No. 3373 lupine seeds with the bitter principle removed, and in No. 3374 steamed lupine seeds were fed. The food, urine, and feces were analyzed. The bitter principle was removed from the lupine seeds by soaking them, then steaming and extracting with cold water.

The following are the principal conclusions reached: Seeds treated as above lose considerable dry matter, mostly nitrogen-free extract, but this is more than made good by the improved quality as a feeding stuff. They are eaten readily, improve the appetite, are more digestible, and improve the digestibility of crude fiber in the coarse fodder fed with them.

Experiments were begun with another sheep, but it became sick and the urine could not be collected.

Nos. 3375, 3376 were made by Weiske, Kennophol, and Schulze at the Institute of Animal Chemistry of the University of Breslau in 1882. The object was to study the digestibility of food by different breeds of sheep. The subjects were a Southdown-Merino and a Rambouillet sheep of about the same weight. The food consisted of meadow hay, barley, and beans, with a little salt. The food, urine, and feces were analyzed. The conclusion was reached that the two breeds of sheep digested the nutrients equally well.

Nos. 3377, 3378 were made by Jordan at the Maine Agricultural Experiment Station in 1885. The object was to compare the fertilizing constituents in a ration containing cotton-seed meal and one containing corn meal. The subject was a full-grown sheep. Three experiments were begun, but only two were successfully completed. In the first period the food consisted of timothy hay and cotton-seed meal, and in the second of timothy hay and corn meal. The nitrogen, phosphoric acid, and potash in the food, urine, and feces were determined.

The principal conclusions reached were the following: The nitrogen, phosphoric acid, and potash in the excretory products are in direct relation to the amount of these ingredients in the food. The urine contained nearly half the potash excreted, from one-half to three-fourths of the nitrogen, and no phosphoric acid [*sic*], this being all excreted in the feces.

Nos. 3379–3383 were made by Weiske, Schulze, and Flechsig at the experiment station in Proskau in 1885 (?). The object was to determine whether cellulose acted as a protector of protein for Herbivora. The subject was a sheep. The basal ration consisted of pea meal and a little salt, to which either oat straw, starch, or starch and sugar were added in different periods. The amount of water consumed was recorded. The food, urine, and feces were analyzed.

The conclusion was reached that digestible cellulose and nitrogen-free extract can take the place of a definite quantity of starch. The subject is discussed at considable length and many references are made to previous work.

Nos. 3384–3394 were made by Wicke and Weiske at the Institute of Animal Chemistry at the University of Breslau in 1895 (?). The object was to investigate the influence of fat and starch on the digestion and assimilation of nutrients. The subjects were two sheep. To a basal ration consisting of hay and clover, or hay and flaxseed, from which the oil had been partially removed, starch or isodynamic quantities of olive oil were added. The food, urine, and feces were analyzed.

The following conclusions were reached: With both subjects the addition of starch to the ration diminished the digestibility and assimilation of fat, and more especially of protein and crude fiber. The addition of fat to the ration did not show a similar marked effect. The addition of starch and fat increased the amount of feces (dry). The addition of starch increased the water content of the feces, while the addition

of fat did not change it. The addition of fat and starch to the ration had no marked effect on the amount of water consumed or urine produced. The metabolism of nitrogen of both subjects was considerably diminished by the addition of starch and fat to the ration, and the effect was more marked with starch than with isodynamic quantities of fat. The gain of nitrogen was increased by the addition of starch and fat. The gain in the case of starch was greater than with isodynamic quantities of fat, provided the quantity of starch consumed did not produce too great a diminution of digestibility of the nitrogenous constituents of the food. On the other hand, it was possible to produce greater gain with fat than with isodynamic quantities of starch, since the fat usually did not diminish the digestibility of the food.

Wicke and Weiske[1] made experiments in continuation of the work reported above to study the influence on metabolism and gain of nitrogen in the animal body of the addition of increasing quantities of fat to the ration. The report of these experiments was received too late for insertion in the tables.

The experiments were made with the same sheep and under the same general experimental conditions noted above. Sheep I, weighing 69 kilograms, received a basal ration of 1,000 grams of meadow hay and 250 grams of linseed cake per day. Sheep II, weighing 56.5 kilograms, received a basal ration of 750 grams of meadow hay and 200 grams of linseed cake. The tests were divided into 4 periods of 7, 5, 6, and 5 days, respectively. In the second period 60 grams of olive oil was added to the ration of Sheep I, and 50 grams to that of Sheep II. In the third period the amount of oil was increased to 120 grams and 100 grams, respectively, and in the fourth period to 180 grams and 150 grams. The balance of income and outgo of nitrogen is shown in the following table:

Nitrogen balance per day in experiments with sheep.

	Animal.	Nitrogen in— Food.	Nitrogen in— Urine.	Nitrogen in— Feces.	Gain (+) or loss (—).
		Grams.	*Grams.*	*Grams.*	*Grams.*
Hay and linseed cake	Sheep I	31.65	22.00	9.10	+0.55
Do	Sheep II	24.42	17.51	7.43	—0.52
Hay, linseed cake, and 60 gm. of olive oil	Sheep I	31.65	20.92	9.23	+1.50
Hay, linseed cake, and 50 gm. of olive oil	Sheep II	24.42	17.07	7.51	—0.16
Hay, linseed cake, and 120 gm. of olive oil	Sheep I	31.65	19.01	8.79	+3.85
Hay, linseed cake, and 100 gm. of olive oil	Sheep II	24.42	16.14	7.57	+0.71
Hay, linseed cake, and 180 gm. of olive oil	Sheep I	31.65	18.62	9.49	+3.54
Hay, linseed cake, and 150 gm. of olive oil	Sheep II	24.42	15.18	7.12	+2.21

The authors discuss the experiment at length. Following are the principal conclusions reached:

The addition of fat to the ration diminished the excretion of nitrogen in the urine, and this decrease was greater the more fat was added, the limit being reached, in the author's opinion, the first day of the fourth period. The addition of the maximum quantity of fat to the ration did not influence the digestibility and assimilation of protein.

INFLUENCE OF OTHER CONDITIONS THAN FEEDING.

In Table 36 are included 50 tests with sheep in health in which the influence of other conditions than feeding were investigated. These conditions were the effect of feeding chiefly during the day and during the night, the influence of drugs, and of variations in the amount of water consumed.

[1] Ztschr. Physiol. Chem., 22 (1896), p. 265.

TABLE 36.—*Experiments with sheep. Influence of other conditions than feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3395	1870	Henneberg and associates.	Sheep III	....	1,230 gm. hay, 6 gm. salt, 1,790 gm. water	8	18.2	8.1	8.3	+1.8	Fed chiefly during the day. In wool 0.8 gm. Nitrogen not taken into account in balance.
3396	1870	...do	Sheep IV	....	1,202 gm. hay, 6 gm. salt, 1,639 gm. water	8	18.0	7.2	8.6	+2.2	Fed chiefly during the day. In wool 0.7 gm. Nitrogen not taken into account in balance.
3397	1870	...do	Sheep III	....	1,148 gm. hay, 6 gm. salt, 1,882 gm. water	8	17.5	7.6	8.1	+1.8	Fed chiefly during the night. In wool 0.8 gm. Nitrogen not taken into account in balance.
3398	1870	...do	Sheep IV	....	1,145 gm. hay, 6 gm. salt, 1,647 gm. water	8	17.6	7.5	7.8	+2.3	Fed chiefly during the night. In wool 0.7 gm. Nitrogen not taken into account in balance. K_2O in food, 21.3 gm.; in urine, 18.0 gm.; in feces, 1.1 gm.; in wool, 0.8 gm.; gain, 2.4 gm. Na_2O in food, 5.7 gm.; in urine, 3.1 gm.; in feces, 1.4 gm.; in wool, 0.0 gm.; gain 1.2 gm. CaO in food, 8.4 gm.; in urine, 0.4 gm.; in feces, 9.4 gm.; in wool, 0.0 gm.; loss, 1.4 gm. MgO in food, 4.5 gm.; in urine, 1.1 gm.; in feces, 3.7 gm.; in wool, 0.0 gm.; loss, 0.3 gm. P_2O_5 in food, 4.1 gm.; in urine, 0.1 gm.; in feces, 4.0 gm.; in wool, 0.0 gm.; gain or loss, 0. SO_3 in food, 2.5 gm.; in urine, 1.3 gm.; in feces, 0.9 gm.; in wool, 0.0 gm.; gain, 0.3 gm. Cl in food, 9.7 gm.; in urine, 8.4 gm.; in feces, 0.0 gm.; in wool, 0.1 gm.; gain, 1.2 gm. SiO_2, Fe, etc., in food, 19.5 gm.; in urine, 0.4 gm.; in feces, 22.3 gm.; in wool, 0.0 gm.; loss, 3.2 gm. Total ash in food, 75.6 gm.; in urine, 32.9 gm.; in feces, 42.8 gm.; in wool, 0.9 gm.; loss. 1.0 gm.
3399	1874	Weiske, Wildt, Pott, and Pfeiffer.	Sheep I	....	642.8 gm. meadow hay, 2,205 gm. straw, 218.8 gm. barley meal, 2,065 gm. water, 5 gm. salt.	8	18.4	8.2	10.2	0.0	

TABLE 36.—*Experiments with sheep. Influence of other conditions than feeding*—Continued.

Serial number.	Date of publication.	Observer.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Remarks.
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm,*	
3400	1874	Weiske, Wildt, Pott, and Pfeiffer.	Sheep II		Food same as No. 3399 with 2,515 gm. water.	8	17.8	7.4	10.3	+0.1	49.3 gm. meadow hay uneaten.
3401	1874	....do	Sheep I		642.8 gm. meadow hay, 220.5 gm. straw, 218.8 gm. barley meal, 2,345 gm. water, 10 gm. salt.	8	18.4	8.6	9.7	+0.1	
3402	1874	....do	Sheep II		642.8 gm. meadow hay, 220.5 gm. straw, 218.8 gm. barley meal. 2,701 gm. water, 10 gm. salt.	8	17.5	7.1	9.1	+1.3	68.8 gm. meadow hay uneaten.
3403	1874	....do	Sheep I		Food same as No. 3399 with 1,708 gm. water	8	17.7	8.2	9.4	+0.1	61.7 gm. meadow hay uneaten.
3404	1874	....do	Sheep II		Food same as No. 3399 with 2,200 gm. water	8	17.0	7.5	8.6	+0.9	118.6 gm. meadow hay uneaten.
3405	1875	Weiske, Schrodt, Pott, and Kellner.	Sheep I		1,000 gm. meadow hay, 250 gm. barley meal, 5 gm. salt.	11	21.6	10.9	8.2	+2.5	Subject was given 0.10 gm. arsenic.
3406	1875	....do	Sheep II		....do	7	21.6	10.5	7.6	+3.5	Subject was given 0.7 gm. arsenic.
3407	1879	Weiske, Schrodt, and Dangel.	Sheep I	58	500 gm. meadow hay, 200 gm. starch, 50 gm. sugar.	5	7.3	3.3	3.7	+0.3	S in food, 1.0 gm.; in urine, 0.6 gm.; in feces, 0.4 gm.; gain or loss, 0.
3408	1879	....do	Shee II	68	....do	5	7.3	3.4	3.6	+0.3	S in food, 1.0 gm.; in urine, 0.5 gm.; in feces, 0.5 gm.; gain or loss, 0.
3409	1879	....do	Sheep I		....do	5	15.1	10.0	3.8	+1.3	Subject was given 42 gm. asparagin. S in food, 1.0 gm.; in urine, 0.4 gm.; in feces, 0.5 gm.; gain, 0.1 gm.
3410	1879	....do	Sheep		500 gm. meadow hay, 80 gm. starch, 20 gm. sugar, 250 gm. pea meal.	5	17.3	11.1	3.8	+2.4	S in food, 1.5 gm.; in urine, 0.8 gm.; in feces, 0.6 gm.; gain, 0.1 gm.
3411	1879	....do	....do		500 gm. meadow hay. 200 gm. starch, 50 gm. sugar, 53 gm. gelatin.	5	15.2	8.7	4.6	+1.9	S in food, 1.3 gm.; in urine, 0.5 gm.; in feces, 0.7 gm.; gain, 0.1 gm.
3412	1879	....do	Sheep II		....do	6	15.2	10.0	4.6	+0.6	S in food, 1.3 gm.; in urine, 0.6 gm.; in feces, 0.7 gm.; gain or loss, 0.
3413	1879	....do	Sheep		500 gm. meadow hay, 115 gm. starch, 15 gm. sugar, 200 gm. pea meal.	5	15.4	9.7	4.0	+1.7	S in food, 1.5 gm.; in urine, 0.6 gm.; in feces, 0.6 gm.; gain, 0.3 gm.
3414	1879	....do	....do		500 gm. meadow hay, 200 gm. starch, 50 gm. sugar.	5	17.4	11.5	3.9	+2.0	Subject was given 53 gm. asparagin. S in food, 1.0 gm.; in urine, 0.5 gm.; in feces, 0.5 gm.; gain or loss, 0.
3415	1881	Weiske, Kennophol, and Schulze.	Sheep I		1,000 gm. meadow hay	6	17.1	9.9	6.2	+1.0	
3416	1881	....do	Sheep II		....do	6	17.1	9.6	6.5	+1.0	
3417	1881	....do	Sheep I		991.4 gm. meadow hay, 250 gm. bean meal	6	25.9	14.7	8.1	+3.1	
3418	1881	....do	Sheep II		1,000 gm. meadow hay, 130 gm. starch. 32 gm. sugar.	6	27.1	16.9	7.8	+2.4	Subject was given 52.5 gm. asparagin.

3419	1881	Weiske, Kennophol, and Schulze.	Sheep I		995.7 gm. meadow hay, 130 gm. starch, 32 gm. sugar.	6	17.2	8.2	7.1	+1.9	
3420	1881	....do	Sheep II		1,000 gm. meadow hay, 130 gm. starch, 32 gm. sugar, 64.4 gm. gelatin.	6	27.1	17.4	7.9	+1.8	
3421	1886	Weiske and Flechsig.	Sheep		1,000 gm. meadow hay, 6 gm. salt, 1,500 c. c. water.	8	19.5	8.5	6.9	+4.1	
3422	1886	....do	....do		1,000 gm. meadow hay, 6 gm. salt	10	20.0	8.4	7.2	+4.4	Subject was given 1,500 c. c. 5 per cent alcohol.
3423	1892	Gabriel	Sheep I	43	1,000 gm. meadow hay	10	13.9	6.1	7.7	+0.1	
3424	1892	....do	....do		1,000 gm. meadow hay, 30 gm. salt	6	13.9	6.1	7.5	+0.3	
3425	1892	....do	....do		1,000 gm. meadow hay	8	13.9	5.7	7.8	+0.4	
3426	1892	....do	....do		1,000 gm. meadow hay, 10 gm. salt	8	13.9	5.5	7.4	+1.0	
3427	1892	....do	Sheep II	43	1,000 gm. meadow hay	9	13.9	6.5	7.5	−0.1	
3428	1892	....do	....do		1,000 gm. meadow hay, 30 gm. salt	6	13.9	6.4	7.0	+0.5	
3429	1892	....do	....do		1,000 gm. meadow hay	8	13.9	6.3	6.9	+0.7	
3430	1892	....do	....do		1,000 gm. meadow hay, 10 gm. salt	8	13.9	6.3	6.8	+0.8	
3431	1892	....do	....do		750 gm. meadow hay, 300 gm. peas	7	22.3	15.0	6.9	+0.4	
3432	1892	....do	....do		750 gm. meadow hay, 300 gm. peas, 30 gm. salt.	6	22.3	13.9	6.6	+1.8	
3433	1892	....do	....do		750 gm. meadow hay, 300 gm. peas	7	22.3	15.0	6.9	+0.4	
3434	1892	....do	....do		....do	7	22.3	15.1	6.4	+0.8	
3435	1892	....do	Sheep III	43	....do	7	22.3	13.5	7.0	+1.8	
3436	1892	....do	....do		750 gm. meadow hay, 300 gm. peas, 30 gm. salt.	6	22.3	13.3	7.0	+2.0	
3437	1892	....do	....do		750 gm. meadow hay, 300 gm. peas	7	22.3	13.8	7.2	+1.3	
3438	1892	....do	....do		....do	7	22.3	13.9	7.1	+1.3	
3439	1895	Gabriel and Weiske.	Sheep I		800 gm. meadow hay, 250 gm. oats, 1,804 c. c. water.	8	15.6	7.3	6.6	+1.7	Water ad libitum.
3440	1895	....do	Sheep II		800 gm. meadow hay, 250 gm. oats, 2,333 c. c. water.	8	15.6	8.2	6.1	+1.3	Do.
3441	1895	....do	Sheep I		800 gm. meadow hay, 250 gm. oats, 1,596 c. c. water.	10	15.6	7.9	6.7	+1.0	Water before eating.
3442	1895	....do	Sheep II		800 gm. meadow hay, 250 gm. oats, 2,127 c. c. water.	10	15.6	8.3	5.9	+1.4	Water after eating.
3443	1895	....do	Sheep I		800 gm. meadow hay, 250 gm. oats, 1,870 c. c. water.	10	15.6	7.9	6.4	+1.3	Do.
3444	1895	....do	Sheep II		800 gm. meadow hay, 250 gm. oats, 1,765 c. c. water.	10	15.6	8.2	6.1	+1.3	Water before eating.

Nos. 3395–3398. Jour. Landw., 1870, pp. 172–175. Nos. 3399, 3400. Jour. Landw., 1874, p. 381. Nos. 3401, 3402. Ibid., p. 385. Nos. 3403, 3404. Ibid., p. 389. Nos. 3405, 3406. Jour. Landw., 1875, p. 325. Nos. 3407–3409. Ztschr. Biol., 15, p. 273. Nos. 3410, 3411. Ibid., p. 280. No. 3412. Ibid., p. 283. Nos. 3413, 3414. Ibid., p. 287. Nos. 3415, 3416. Ztschr. Biol., 17, p. 422. Nos. 3417, 3418. Ibid., p. 424. Nos. 3419, 3420. Ibid., p. 426. Nos. 3421, 3422. Jahresber. agr. Chem., 29, pp. 555, 556. Nos. 3423–3426. Ztschr. Biol., 29, p. 560. Nos. 3427–3430. Ibid., p. 563. Nos. 3431–3434. Ibid., p. 566. Nos. 3435–3438. Ibid., p. 567. Nos. 3439–3444. Landw. Vers. Stat., 45, p. 317.

Nos. 3395–3398. See Nos. 3648–3650, Table 38.

Nos. 3399–3404 were made by Weiske and associates at the experiment station in Proskau in 1874 (?). The object was to investigate the influence of salt and water on nitrogen metabolism, on the weight of the subject, and on the digestibility of various feeding stuffs. The subjects were sheep about 3 years old. The experiment was divided into three periods. The food consisted of meadow hay, straw, and barley meal. During the first period 5 grams of salt was added to the ration. In the second period the amount was increased to 10 grams. In the third period no salt was given. Water was supplied ad libitum. Each period was preceded by a preliminary period of about two weeks' duration on the same diet. Food, urine, and feces were analyzed.

The following conclusions were reached: Increasing the amount of salt in the food increased the amount of water consumed and urine excreted. Since the increased salt and water consumption increased the amount of urine, it also increased the nitrogen metabolism. When no salt was consumed much less water was drunk, and the quantity of urine excreted and of nitrogen metabolized also diminished.

Other conclusions were drawn which have to do with gains in weight and digestibility.

Nos. 3405, 3406 were made by Weiske and associates at the experiment station in Proskau in 1875 (?). The object was to investigate the influence of arsenic upon the digestibility of food and upon nitrogen metabolism. These experiments were made immediately after the close of experiments Nos. 3358–3361, with the same sheep and the same ration, with the addition of 0.1 gram arsenic acid. The conclusion was that small quantities of arsenic diminished the excretion of nitrogen in the urine and increased the digestibility of the food.

Nos. 3407–3414 were made by Weiske, Schrodt, and Dangel at the experiment station in Proskau in 1878 to study the value of asparagin for the nourishment of animals. The subjects were 2 sheep. The basal ration consisted of meadow hay, starch, and sugar. Asparagin, pea meal, and gelatin were each added to the ration in two periods. Analyses were made of food, urine, and feces. The balance of income and outgo of nitrogen and sulphur was determined.

The experiments showed that asparagin has a decided value in the diet, and is a nutrient in the same way that gelatin is. It acts as a protector of protein and diminishes the nitrogen metabolism when fed in a diet containing little protein, though it does not serve for the formation of nitrogenous tissue.

Nos. 3415–3420 were made by Weiske, Kennophol, and Schulze at the experiment station in Proskau in 1879–80 and are a continuation of Nos. 3407–3414. The subjects were 2 sheep. The experiment was divided into three periods. In the first period (Nos. 3415, 3416) the food consisted of meadow hay. In the second period (Nos. 3417, 3418) both sheep were fed about the same amount of meadow hay. In addition Sheep I was fed bean meal and Sheep II starch, sugar, and asparagin, furnishing approximately as much nitrogen and nitrogen-free material as the bean meal. In the third period (Nos. 3419, 3420) both sheep were given starch and sugar in addition to the basal ration of meadow hay, and Sheep II was given gelatin in addition.

The food, urine, and feces were analyzed. The conclusion was reached that asparagin served as a protector of protein.

Nos. 3421 and 3422 were made by Weiske and Flechsig in 1885 to study the influence of alcohol on Herbivora. The subject was a Southdown-Merino sheep. In No. 3421 the food consisted of meadow hay and a little salt and water. In No. 3422 the food was the same except that an equal amount of 5 per cent alcohol was substituted for water. Food, urine, and feces were analyzed.

The conclusion was reached that the alcohol diminished the digestibility of the food very little, if any. No marked change in the amount of nitrogen in the urine was observed.

Other experiments with larger doses of alcohol were begun but not finished, because the animal did not take the alcohol readily and lost his appetite. In the

authors' opinion the large doses of alcohol seemed to increase the metabolism of nitrogen.

Nos. 3423–3438 were made by Gabriel at the Institute of Animal Chemistry of the University of Breslau in 1892–93. The object was to study the influence of salt on the digestibility and metabolism of protein. The subjects were 3 sheep in medium condition. The food consisted of meadow hay or meadow hay and peas, with or without salt. The food, urine, and feces were analyzed.

The results obtained were contradictory. The author concludes, therefore, that salt is not one of the substances which under all conditions and circumstances exercises a marked influence on the metabolism of protein or a definite effect on digestibility.

Nos. 3439–3444 were made by Gabriel and Weiske at the Institute of Animal Chemistry of the University of Breslau in 1893. The object was to study the influence of drinking water ad libitum and before and after eating on the digestibility of nutrients and the metabolism of nitrogen. The subjects were 2 Southdown-Merino sheep. The food, which consisted of meadow hay and oats, was fed in three portions daily. Analyses were made of food and feces. The specific gravity and nitrogen of the urine were determined. In the first period both sheep drank water ad libitum. In the second period Sheep I drank water before and Sheep II after eating. In the third period the conditions were reversed.

The author concludes that as far as the metabolism of nitrogen or the digestibility of the nutrients of the food was concerned it was immaterial in which way the water was consumed.

Somewhat more water was consumed when it was drank at will or after eating than when it was consumed before eating. In all the periods some undigested oats were found in the feces. The water and dry matter contained in the feces was practically the same under the different experimental conditions. The fresh feces in the first period contained 53 per cent water, in the second period 50.5 per cent, and in the third 48.4 per cent.

The author cites experiments by Kühn made with steers. The subjects were fed wheat bran and hay, with and without water. The coefficients of digestibility were practically the same in both cases.

EXPERIMENTS WITH SWINE.

INFLUENCE OF FEEDING.

In Table 37 are included 18 tests with swine in which the conditions were not abnormal or unusual. Some of these tests were made in connection with feeding experiments, while others were made for the purpose of studying special points. Those which have to do with the question of the formation of fat in the animal organism (Nos. 3445 and 3446) are of special historical interest. The theory was advanced by some of the earlier investigators that animals took the material used in the formation of fatty tissue ready-made from vegetable foods. For many years it was a disputed point whether or not fat was formed from carbohydrates, and also whether it could be formed from protein. It is now generally conceded that fat is formed from fat and carbohydrates consumed, though the possibility of its formation from protein under certain circumstances is also quite generally admitted.[1]

[1] S. Soskin: The formation of fat in the animal body. Experiment Station Record, 8, p. 179.

TABLE 37.—*Experiments with swine. Influence of feeding.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	
3445	1845	Boussingault	Pig		7,000 gm. potatoes, 25 gm. salt	3	25.3	6.9	9.2	+ 9.2	Observer gives 9.2 gm. nitrogen in respiratory products.
3446	1845	....do	....do		3,800 gm. potatoes, 2,500 gm. kitchen slop, 10 gm. salt.	3	17.3	3.9	3.8	+ 9.6	Observer gives 9.6 gm. nitrogen in respiratory products.
3447	1885	Pfeiffer	Pig I	23.0	1,050 gm. barley meal, 2,400 gm. water, 5 gm. salt, 5 gm. calcium carbonate.	6	16.2	6.6	3.7	+ 5.9	Ash in food 38.2 gm., in urine 14.7 gm., in feces 17.7 gm.; gain 5.8 gm.
3448	1885	....do	Pig II	22.1	....do	6	16.3	6.0	4.4	+ 5.9	Ash in food 38.5 gm., in urine 14.0 gm., in feces 18.7 gm.; gain 5.8 gm.
3449	1885	....do	Pig I	27.1	510–600 gm. starch, 120–150 gm. sugar, 270–300 gm. paper fiber, 25 gm. oil, 25 gm. sodium phosphate, 12 gm. tricalcium phosphate, 10 gm. potassium chlorid, 5 gm. calcium carbonate, 3,000 gm. water.	7	0.2	1.2	2.2	— 3.2	Ration without protein. Ash in food 54.6 gm., in urine 33.9 gm., in feces 13.6 gm.; gain 7.1 gm.
3450	1885	....do	Pig II	26.0	....do	7	0.1	1.3	1.8	— 3.0	Ration without protein. Ash in food 53.0 gm., in urine 32.7 gm., in feces 13.2 gm.; gain 7.1 gm.
3451	1885	....do	Pig I	25.7	Same as No. 3449, with 105 gm. conglutin	4	10.1	3.3	1.7	+ 5.1	
3452	1885	....do	Pig II	24.0	....do	4	7.1	2.7	1.2	+ 3.2	
3453	1892	Kornauth and Arche.	Pig		400 gm. corn cockles, 300 gm. barley, 300 gm. maize, 3 gm. salt, 1 gm. calcium phosphate.	21	19.2	10.6	3.4	+ 5.2	
3454	1893	Snyder	Pig	113.4	4,000 gm. barley and shorts (1:1), — gm. water	7	88.8	36.9	20.7	+31.2	Ash in food 112.7 gm., in urine 7.1 gm., in feces 105.6 gm., loss 1.0 gm.
3455	1893	....do	Pig	122.9	2,721 gm. barley, 4,082 gm. water	6	50.4	38.6	9.3	+ 2.5	
3456	1893	....do	Pig	107.1	2,313 gm. corn and shorts (1:1), 3,173 gm. water.	7	42.8	34.2	8.7	— 0.1	
3457	1893	....do	Pig	112.0	2,948 gm. corn, 3,175 gm. water	7	51.8	33.7	6.5	+11.6	
3458	1893	....do	Pig		2,004 gm. corn and bran (1:1), 3,623 gm. water.	7	39.5	14.3	9.1	+16.1	
3459	1893	....do	Pig		1,878 gm. peas and bran (1:1), — gm. water.	7	59.0	25.9	9.7	+23.4	
3460	1891	Kornauth	Pig		2,500 gm. whey, 800 gm. corn and barley meal.	7	17.8	8.3	2.3	+ 7.2	
3461	1891	....do	Pig		....do	7	17.1	8.0	2.0	+ 7.1	Subject was given 3 gm. saccharinum purum.
3462	1891	....do	Pig		....do	6	17.5	7.8	2.2	+ 7.5	

Nos. 3445, 3446. Ann. Chim. et Phys., ser. 3, 14, p. 443. Nos. 3447, 3448. Jour. Landw., 33, p. 535. Nos. 3449, 3450. Ibid., p. 166. Nos. 3451, 3452. Ibid., p. 178. No. 3453. Landw. Vers. Stat., 40, p. 187. Nos. 3454, 3455. Minnesota Sta. Bul., 26, pp. 22, 23. Nos. 3456, 3457. Ibid., pp. 26, 28. Nos. 3458, 3459. Ibid., pp. 31, 32. Nos. 3460–3462. Landw. Vers. Stat., 38, p. 253.

Nos. 3445, 3446 were made by Boussingault in 1845 and formed part of an extended investigation of the formation of fat in the animal organism. The subject was a pig. The food consisted of potatoes and salt, with and without slop. Elementary analyses of the food, urine, and feces were made.

One of the conclusions reached was that nitrogen was excreted in the gaseous respiratory products. The other conclusions have to do largely with the special question of the formation of fat. These are the experiments of Boussingault, which are often quoted in the discussion of formation of fat in the animal organism.

Nos. 3447–3452 were made by Pfeiffer at the Agricultural Experiment Station in Göttingen in 1883, to learn how much of the nitrogen of the feces was due to metabolic products and to study the nature of such nitrogenous metabolic products. The subjects were 2 young pigs. The experiment covered three periods. In the first period an abundant ration of barley meal, with some salt and calcium carbonate, was fed. In the second period the ration was of about the same nutritive value, except that it contained no protein. It was made up of sugar, starch, paper fiber, and olive oil, with a mixture of mineral salts, which were believed to be necessary. In the third period the ration was the same as during the second period, with the addition of conglutin, a protein compound, which in the author's opinion would be thoroughly assimilated.

The food and feces were analyzed, the usual determinations being made. In addition, the mucin in the feces was determined and the nitrogen and ash in the feces. Nitrogenous metabolic products—e. g., mucin—were found in the feces in all three periods. In other words, when the food contained no nitrogen metabolic nitrogen was still found in the feces. In the first period the feces of the 2 pigs contained 0.7 gram and 0.8 gram of mucin and 150.0 grams and 158.7 grams of dry matter, respectively; in the second period 0.9 gram and 0.8 gram mucin and 262.5 grams and 249.5 grams dry matter; and in the third period 2.2 grams and 1.6 grams mucin and 204.5 grams and 173.3 grams dry matter.

The following are the principal conclusions reached: The nitrogenous metabolic products in the feces must be taken into account in all investigations of the nutritive value of feeding stuffs. The amount of nitrogenous metabolic products in the feces is proportional to the amount of dry matter digested. For swine the relations are such that 0.7 gram of nitrogen may be assumed in the feces for every 100 grams of dry matter digested. This agrees with the value found by Kellner for Herbivora.

The author discusses the subject at length, quoting the work of Rieder, Kellner, and other investigators.

No. 3453. See Nos. 3658, 3659, Table 38.

Nos. 3454–3459 and Nos. 2324, 2325, Table 27, were made by Snyder at the University of Minnesota in 1893 in connection with a study of the digestibility of a number of feeding stuffs by milch cows and growing pigs. Six pigs were used in the test. They were fed barley, corn, and peas separately and in combination with bran and shorts. Full analyses of the food and feces were made. The nitrogen, phosphoric acid, and potash in the urine and feces were also determined. The coefficients of digestibility of the different feeding stuffs are reported.

Among the conclusions reached are the following:

When no nitrogen was retained in the body there was a slight loss in weight. There was a corresponding gain in weight when a little nitrogen was retained. When 250 grams of digestible protein was fed per day, the pigs consuming barley and corn and shorts made no perceptible gains. When the digestible protein was increased to about 375 grams and the other nutrients increased in the same proportion the pigs made a fair gain. When the nutrients were still further increased the gains were correspondingly large. Whether the pigs were gaining or losing in weight about 35 grams of nitrogen per day was excreted in the urine. The amount of nitrogen excreted in the feces varied with the character of the food. When the digestible protein of the food was increased above the amount required to maintain the animal nearly all this increase was stored up in the body.

A practical deduction drawn from the tests was that for every 2,948 grams of barley or corn fed to a pig weighing 114 kilograms about 2,722 grams is used up in the mechanical processes of the body, and only about 227 grams goes to form flesh. The chief benefits that are derived from the food come from the amount in excess of that required for maintenance. The general deduction is drawn that it is unprofitable to feed small or unbalanced rations when fattening mature animals.

Nos. 3460–3462 were made by Kornauth at the Imperial Experiment Station of Agricultural Chemistry in Vienna in 1871 in connection with a study of saccharin, and form a series with the experiments with a duck included in Table 31 (Nos. 3034, 3035). The pig used as the subject of Nos. 3460–3462 was fed corn and barley (equal parts) and whey. A period on normal diet preceded and followed a period in which saccharin was added to the food. The usual analyses of food, urine, and feces were made. The nitrogen in the urine and feces was determined by the Kjeldahl method and the azometric method.

The author also made experiments with rabbits and a dog. The balance of income and outgo of nitrogen was, however, not determined. The dog was fed as much as 59 grams of saccharin per day. It did not relish the saccharin at first, but gradually became accustomed to it. A post-mortem examination revealed nothing abnormal.

From all the experiments the conclusion was reached that feeding saccharin for a long time and in large doses had no bad effects. The fact that the subjects did not relish saccharin was attributed to individual peculiarities. Generally speaking, the coefficients of digestibility were not lowered when saccharin was taken.

EXPERIMENTS IN WHICH THE BALANCE OF NITROGEN AND CARBON WAS DETERMINED.

The number of experiments with animals in which the balance of income and outgo of carbon was determined, with or without oxygen, hydrogen, and mineral matter, is large. Such experiments necessitated the measurement and analysis of the products of respiration. For this purpose special apparatus has been devised, to which the name respiration apparatus has been applied. As noted in the section devoted to respiration experiments with man, such apparatus may be conveniently divided into three classes: (1) Apparatus in which the oxygen is supplied to a limited volume of air to take the place of that used, (2) apparatus in which a current of air is constantly supplied, and (3) a device worn over the mouth or a tube inserted in the throat which permits the measurement of the oxygen of the inspired air and the carbon dioxid of the expired air. The apparatus designed by Regnault and Reiset[1] may be taken as a type of the first, that of Pettenkofer[2] of the second, and that of Zuntz[3] of the third. Apparatus of the first two types has usually been employed in determining the balance of income and outgo of carbon. The apparatus of Zuntz has been usually employed to determine the respiratory quotient, i. e., the ratio of inspired oxygen to expired carbon dioxid. Experiments of this nature are very important and furnish the basis for interesting and valuable deductions concerning the laws of metabolism. However, no attempt has been made to include them in the present compilation, since they are very numerous and it was believed they could more properly form a subject by themselves.

The apparatus used in the experiments with animals here cited was essentially the same in principle and construction as that used in experiments with man.

RESPIRATION EXPERIMENTS.

In Table 38 are included 37 respiration experiments with steers, 6 with calves, 7 with cats, 99 with dogs, 5 with doves and poultry, 1 with a horse, 30 with rabbits, 4 with sheep, and 8 with swine. The special problems discussed are noted in the text of the individual experiments.

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[1] Ann. Chim. et Phys., ser. 3, 26, p. 310.

[2] Ann. Chem. Sup. II, p. 1. For description of a smaller form devised by Voit, see U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 109.

[3] Landw. Jahrb., 1889, p. 1.

TABLE 38—PART I.—*Respiration experiments.*

Serial number.	Date of publication.	Subject.		Food per day.	Duration.	Nitrogen.				Carbon.				
		Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3463	1868	Steer II	712.5	5,000 gm. clover hay, 6,000 gm. oat straw, 3,700 gm. bean meal, 75 gm. salt, 56,100 gm. water.	19	310.0	170.0	105.0	+35.0	5,825.0	220.0	2,585.0	2,690.0	+ 330.0
3464	1868	Steer I	637.5	4,095 gm. clover hay, 4,910 gm. oat straw, 235 gm. bean meal, 142 gm. starch, 475 gm. sugar, 305 gm. salts, 35,875 gm. water.	32	135.0	110.0	75.0	—50.0	4,375.0	135.0	1,870.0	2,070.0	+ 300.0
3465	1868	Steer	....	4,500 gm. clover hay, 5,500 gm. oat straw	......	130.0	60.0	70.0	0.0	3,855.0	130.0	1,955.0	1,785.0	— 15.0
3466	1868	do	....	4,500 gm. clover hay, 5,500 gm. oat straw, 750 gm. gluten.	......	250.0	150.0	70.0	+30.0	4,255.0	170.0	1,955.0	1,960.0	+ 170.0
3467	1868	do	....	4,500 gm. clover hay, 5,500 gm. oat straw, 1,500 gm. gluten.	......	370.0	260.0	70.0	+40.0	4,650.0	215.0	1,955.0	2,030.0	+ 450.0
3468	1871	Steer I	637.5	4,095 gm. clover hay, 4,910 gm. oat straw, 235 gm. bean meal, 142 gm. starch, 475 gm. sugar, 305 gm. salts, 35,875 gm. water.	32	135.5	62.5	72.5	+ 0.5	4,375.0	140.0	1,870.0	1,396.0	+ 919.0
3469	1871	do	642.7	4,385 gm. clover hay, 5,260 gm. oat straw, 75 gm. salt, 31,600 gm. water.	11	131.0	66.5	65.5	— 1.0	3,830.0	130.0	1,920.0	1,145.0	+ 635.0
3470	1871	do	660.3	4,435 gm. clover hay, 5,320 gm. oat straw, 75 gm. salt, 31,975 gm. water.	6	131.0	60.0	67.5	+ 3.5	3,860.0	135.0	1,955.0	1,202.0	+ 568.0
3471	1871	Steer II	696.6	4,960 gm. clover hay, 5,950 gm. oat straw, 3,620 gm. bean meal, 1,240 gm. starch, 75 gm. salt, 55.770 gm. water.	17	306.5	159.5	110.0	+37.0	6,135.0	215.0	2,700.0	1,740.0	+1,480.0
3472	1871	do	700.9	4,955 gm. clover hay, 5,950 gm. oat straw, 250 gm. bean meal, 1,985 gm. starch, 320 gm. salts, 44,700 gm. water.	10	161.5	77.5	90.0	— 6.0	5,145.0	155.0	2,365.0	1,564.0	+1,061.0
3473	1871	do	715.1	4,970 gm. clover hay, 5,965 gm. oat straw, 200 gm. bean straw, 3,230 gm. starch, 320 gm. salts, 51,105 gm. water.	11	160.0	59.0	97.5	+ 3.5	5,545.0	155.0	2,575.0	1,686.0	+1,129.0
3474	1871	do	712.0	5,000 gm. clover hay, 6,000 gm. oat straw, 3,700 gm. bean meal, 75 gm. salt, 56.080 gm. water.	19	311.5	171.0	103.0	37.5	5,830.0	215.0	2,585.0	1,825.0	+1,205.0
3475	1871	do	726.1	4,985 gm. clover hay, 5,980 gm. oat straw, 3.640 gm. bean meal, 1,245 gm. starch, 75 gm. salt, 56,115 gm. water.	17	308.5	146.5	107.5	54.5	6,205.0	210.0	2,675.0	1,940.0	+1,380.0
3476	1894	Steer I	....	8,801 gm. hay, 1,671 gm. starch, 29,680 gm. water.	5	140.0	67.1	71.7	+ 1.2	4,816.9	217.2	1,720.4	2,551.9	+ 327.4
3477	1894	do	....	8,657 gm. hay, 1,667 gm. starch, 31,030 gm. water.	5	136.1	68.3	70.1	— 2.3	4,748.3	223.9	1,689.3	2,565.9	+ 269.2

TABLE 38—PART II.—*Respiration experiments.*

Serial number.	Subject. Kind of animal.	Subject. Weight.	Oxygen. Total consumed.	Oxygen. Total excreted.	Oxygen. Gain (+) or loss (—).	Hydrogen. Total consumed.	Hydrogen. Total excreted.	Hydrogen. Gain (+) or loss (—).	Ash. In food.	Ash. In urine.	Ash. In feces.	Ash. Gain (+) or loss (—).	Remarks.	Observer.
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3463	Steer II	712.5	63,890	63,340	+550	7,215	7,105	+110	890	305	575	+10		Henneberg.
3464	Steer I	637.5	42,490	43,195	—705	4,740	4,780	— 40	785	305	495	—15		Do.
3465	Steer													Do.
3466	....do													Do.
3467	....do													Do.
3468	Steer I	637.5							795	305	495	— 5		Henneberg and associates.
3469	....do	642.7							680	220	440	+20		Do.
3470	....do	660.3							685	250	440	— 5		Do.
3471	Steer II	696.6							925	330	625	—30		Do.
3472	....do	700.9							930	320	590	+20		Do.
3473	....do	715.1							955	320	630	+ 5		Do.
3474	....do	712.0							905	305	575	—25		Do.
3475	....do	726.1							925	300	620	+ 5		Do.
3476	Steer I												Period II a	Kühn and associates.
3477	....do												Period II b	Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Carbon. In food.	Carbon. In urine.	Carbon. In feces.	Carbon. In respiratory products.	Carbon. Gain (+) or loss (—).
			Kg.		Days.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.
3478	1894	Steer II		8,734 gm. hay, 350 gm. starch, 22,840 gm. water.	4	129.1	65.9	63.1	+ 0.1	3,887.6	202.7	1,595.2	2,021.4	+ 68.3
3479	1894	....do		8,302 gm. hay, 1,694 gm. starch, 28,670 gm. water.	5	131.1	54.5	68.9	+ 7.7	4,597.2	203.7	1,653.0	2,383.1	+357.4
3480	1894	Steer III		3,853 gm. clover hay, 3,892 gm. oat straw, 25,300 gm. water.	5	101.6	56.7	47.5	— 2.5	3,618.2	160.7	1,598.5	1,809.6	+ 49.4
3481	1894	....do		3,741 gm. clover hay, 3,856 gm. oat straw, 1,656 gm. starch, 31,190gm. water.	5	100.0	35.1	55.2	+ 9.7	4,289.4	139.8	1,722.0	2,181.5	+246.1
3482	1894	....do		3,676 gm. clover hay, 3,797 gm. oat straw, 1,668 gm. starch, 584 gm. gluten, 28,880 gm. water.	5	180.0	108.6	57.2	+14.2	4,541.2	198.3	1,662.3	2,346.5	+334.1
3483	1894	....do		3,795 gm. clover hay, 3,825 gm. oat straw, 1,673 gm. starch, 1,173 gm. gluten, 31,460 gm. water.	4	265.9	194.3	63.5	+ 8.1	4,922.7	262.4	1,722.2	2,509.1	+429.0
3484	1894	Steer IV		3,763 gm. clover hay, 3,864 gm. oat straw, 23,010 gm. water.	5	99.5	54.7	45.3	— 0.5	3,561.9	158.1	1,536.1	1,781.4	+ 86.4
3485	1894	....do		3,675 gm. clover hay, 3,801 gm. oat straw, 23,420 gm. water.	5	97.4	56.8	46.3	— 5.7	3,491.6	160.1	1,579.6	1,833.3	— 81.4
3486	1894	....do		3,777 gm. clover hay, 3,810 gm. oat straw, 1,611 gm. starch 28,090 gm. water.	4	100.5	38.8	55.0	+ 6.7	4,263.7	145.3	1,786.1	2,187.7	+144.6
3487	1894	....do		3,844 gm. clover day, 3,859 gm. oat straw, 1,615 gm. starch, 590 gm. gluten, 28,030 gm. water.	5	184.7	116.2	59.6	+ 8.9	4,627.6	201.9	1,724.4	2,374.7	+326.6
3488	1894	Steer V		7,784 gm. clover hay, 23,740 gm. water	5	128.4	63.6	56.3	+ 8.5	3,595.8	152.5	1,532.1	1,787.9	+123.3
3489	1894	....do		7,726 gm. clover hay, 1,626 gm. starch, 27,910 gm. water.	5	128.3	51.9	62.4	+14.0	4,297.6	154.0	1,611.1	2,183.1	+349.4
3490	1894	....do		7,708 gm. clover hay, 1,666 gm. starch, 27,740 gm. water.	4	128.2	57.6	66.6	+ 4.0	4,305.9	152.5	1,663.3	2,165.2	+324.9
3491	1894	....do		7,726 gm. clover hay, 2,937 gm. starch, 31,430 gm. water.	4	128.7	38.6	79.3	+10.8	4,884.4	140.4	1,801.2	2,369.2	+573.6
3492	1894	Steer VI		7,703 gm. clover hay, 22,310 gm. water	4	127.1	67.1	53.7	+ 6.3	3,558.2	172.4	1,412.3	1,835.3	+138.2
3493	1894	....do		7,555 gm. clover hay, 1,682 gm. starch, 28,510 gm. water.	4	125.4	49.2	64.9	+11.3	4,243.0	153.4	1,554.8	2,264.5	+270.3
3494	1894	....do		7,776 gm. clover hay, 1,673 gm. starch, 29,550 gm. water.	4	129.0	51.9	64.8	+12.3	4,340.5	150.4	1,579.2	2,278.7	+332.2
3495	1894	....do		7,747 gm. clover hay, 2,795 gm. starch. 31,870 gm. water.	3	129.8	44.4	68.9	+16.5	4,824.5	155.5	1,634.4	2,591.9	+442.7
3496	1894	Steer XX		8,482 gm. clover hay, 28,710 gm. water	4	149.9	83.2	63.4	+ 3.3	3,891.2	327.0	1,406.1	2,079.6	+ 78.5
3497	1894	....do		8,479 gm. clover hay, 857 gm. meatmeal, 34,160 gm. water.	4	284.0	191.9	71.6	+20.5	4,332.0	414.6	1,481.1	2,283.0	+153.3

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or (loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3478	Steer II												Period I	Kühn and associates.
3479	do												Period II	Do.
3480	Steer III												Period I	Do.
3481	do												Period II	Do.
3482	do												Period III	Do.
3483	do												Period IV	Do.
3484	Steer IV												Period I a	Do.
3485	do												Period I b	Do.
3486	do												Period II	Do.
3487	do												Period III	Do.
3488	Steer V												Period I	Do.
3489	do												Period II a	Do.
3490	do												Period II b	Do.
3491	do												Period III	Do.
3492	Steer VI												Period I	Do.
3493	do												Period II a	Do.
3494	do												Period II b	Do.
3495	do												Period III	Do.
3496	Steer XX												Period I	Do.
3497	do												Period II a	Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject.		Food per day.	Duration.	Nitrogen.				Carbon.				
		Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3498	1894	Steer XX		8,635 gm. clover hay, 855 gm. meat meal, 32,070 gm. water.	3	286.5	201.1	73.6	+11.8	4,402.4	426.2	1,497.7	2,341.7	+136.8
3499	1894	....do		8,879 gm. clover hay, 857 gm. meat meal, 1,635 gm. starch, 34,020 gm. water.	4	291.8	189.1	84.1	+18.6	5,245.0	446.4	1,619.3	2,887.3	+292.0
3500	1878	Steer calf A I	44.2	7,307 gm. milk	3	30.0	6.8	2.6	+20.6					
3501	1878	Steer calf A II	56.9	9,035 gm. milk	3	39.1	10.4	2.5	+26.2					
3502	1878	Steer calf B I	62.9	10,531 gm. milk	3	55.3	15.8	2.4	+37.1	655.2	16.2	12.0	356.6	+270.4
3503	1878	Steer calf B II	68.7	10,429 gm. milk	3	52.6	16.2	1.8	+34.6	652.8	16.0	10.0	372.3	+280.5
3504	1878	Steer calf C	48.5	8,352 gm. milk	1	44.3	9.7	2.3	+32.3	507.0	11.2	11.2	258.1	+226.5
3505	1878	Steer calf	50.0	3,093 gm. milk		39.2	10.2	2.2	+26.8	488.0	11.6	9.0	257.6	+209.8
3506	1852	Cat	3.2	236.8 gm. meat, 57.1 gm. water, 64.2 gm. oxygen from air.	8	8.6	7.8	0.0	+ 0.8	40.9	3.3	0.6	20.3	+ 16.7
3507	1852	....do		Fasting; 131.5 gm. water	18	0.0	1.7	0.0	— 1.7	0.0	0.7	0.1	10.6	— 11.4
3508	1852	....do	3.2	142.4 gm. meat, 87.8 gm. water, 60.1 gm. oxygen from air.	9	4.5	4.5	0.0	0.0	20.0	1.9	0.2	17.9	0.0
3509	1852	....do	3.3	247.3 gm. meat, 51.3 gm. water, 103.8 gm. oxygen from air.	2⅛	7.8	7.8	0.0	0.0	34.8	3.0	0.5	31.0	0.0
3510	1852	....do	3.3	150 gm. meat, 63.5 gm. ogygen from air	23	4.7	4.6	0.0	+ 0.1	21.1	2.0	0.2	18.9	0.0
3511	1852	....do	2.8	Fasting; 1,446 gm. water, 44.6 gm. oxygen from air.	6	0.0	1.6	0.0	— 1.6	0.0	0.8	0.0	12.6	— 13.4
3512	1852	....do	1.2	98 gm. meat, 12.2 gm. water, 41.2 gm. oxygen from air.	9	3.1	3.1	0.0	0.0	13.8	1.3	0.2	12.3	0.0
3513	1852	Dog	3.9	103.8 gm. lean meat, 58.9 gm. water, 101.2 gm. oxygen from air.	1	3.3	5.5	0.1	— 2.3	14.6	2.4	0.7	29.3	+ 17.8
3514	1852	Dog	5.4	549 gm. lean meat, 201.1 gm. water, 160.1 gm. oxygen from air.	1	19.2	18.1	0.2	+ 0.9	79.3	7.8	10.9	49.7	+ 10.9

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject: Kind of animal.	Subject: Weight.	Oxygen: Total consumed.	Oxygen: Total excreted.	Oxygen: Gain (+) or loss (—).	Hydrogen: Total consumed.	Hydrogen: Total excreted.	Hydrogen: Gain (+) or loss (—).	Ash: In food.	Ash: In urine.	Ash: In feces.	Ash: Gain (+) or loss (—).	Remarks.	Observer.
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3498	Steer XX												Period II b	Kühn and associates.
3499	do												Period III	Do.
3500	Steer calf A I	44.2							52.5	23.2	1.8	+21.2		Soxhlet.
3501	Steer calf A II	56.9							67.9	30.9	2.4	+34.6		Do.
3502	Steer calf B I	62.9							80.8	35.4	1.5	+43.9		Do.
3503	Steer calf B II	68.7							81.3	35.3	1.9	+44.1		Do.
3504	Steer calf C	48.5							66.2	29.9	1.2	+35.1		Do.
3505	Steer calf	50.0							62.0	27.4	1.6	+33.0	Calculated average for calf 2 to 3 weeks old. P_2O_5 in food, 19 gm.; in urine, 5 gm.; in feces, 0.2 gm.; gain, 13.8 gm. CaO in food, 15 gm.; in urine, 0 gm.; in feces, 0.5 gm.; gain, 14.5 gm.	Do.
3506	Cat	3.2	78.0	75.1	+2.9				2.8	2.2	0.5	+0.1	S in food, 0.5 gm.; in urine, 0.2 gm.; in feces, 0.1 gm.; gain, 0.2 gm.	Bidder and Schmidt.
3507	do								0.0	1.1	0.5	—0.6	S in food, 0; in urine, 0.1 gm.; in feces, 0.2 gm.; loss, 0.1 gm.	Do.
3508	do	3.2	67.2	67.2	0.0				1.4	1.3	0.1	0.0	S in, food, 0.0 gm.; in urine, 0.1 gm., in feces, 0.1 gm.; gain, 0.1 gm.	Do.
3509	do	3.3	116.1	116.1	0.0				2.5	2.1	0.4	0.0	S in food, 0.5 gm.; in urine, 0.1 gm.; in feces, 0.4 gm.; gain or loss 0.	Do.
3510	do	3.3	70.9	70.9	0.0				1.3	1.4	0.1	0.0	S in food, 0.3 gm.; in urine, 0.1 gm.; in feces, 0.2 gm.; gain or loss, 0.	Do.
3511	do	2.8	47.9	47.9	0.0				0.0	0.6	0.0	0.6	S in food, 0.1 gm.; in urine, 1.1 gm.; in feces, 0; loss, 1.1 gm.	Do.
3512	do	1.2	46.1	46.1	0.0				1.0	0.9	0.1	0.0	S in food, 0.2 gm.; in urine, 0.1 gm.; in feces, 0.1 gm.; gain or loss, 0.	Do.
3513	Dog	3.9	106.4	110.6	—4.2	2.0	4.5	—3.2	1.2	2.1	0.2	—1.1	In dry gall 0.2 gm. N, 2.9 gm. C, 0.4 gm. H, 0.9 gm. O, 0.3 gm. S, 0.5 gm. ash.	Do.
3514	Dog	5.4	189.1	186.1	+3.0	10.8	8.9	+1.9	6.1	3.3	1.3	+1.5	In dry gall 0.6 gm. N, 9.8 gm. C, 1.4 gm. H, 3.0 gm. O, 0.9 gm. S, 1.5 gm. ash.	Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Carbon. In food.	Carbon. In urine.	Carbon. In feces.	Carbon. In respiratory products.	Carbon. Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3515	1852	Dog	5.4	526.2 gm. lean meat, 193.5 gm. water, 149.5 gm. oxygen from air.	1	18.4	17.0	0.4	+ 1.0	76.0	7.3	15.2	46.9	+ 6.6
3516	1862-63	Dog	30	1,500 gm. lean meat, 647.0 gm. oxygen from air.	1	51.0	51.7	0.7	— 1.4	187.8	31.1	4.8	154.6	— 2.7
3517	1862-63	...do		1,500 gm. lean meat, 375.6 gm. oxygen from air.	1	51.0	48.4	0.8	+ 1.8	187.8	29.1	5.6	141.0	+ 12.1
3518	1862-63	...do		1,500 gm. lean meat, 309.5 gm. oxygen from air.	1	51.0	48.9	0.6	+ 1.5	187.8	29.4	4.1	122.5	+ 31.8
3519	1862-63	...do		1,500 gm. lean meat, 423.6 gm. oxygen from air.	1	51.0	51.1	0.6	— 0.7	187.8	30.7	4.1	139.6	+ 13.4
3520	1862-63	...do		1,500 gm. lean meat, 457.2 gm. oxygen from air.	1	51.0	51.3	0.6	— 0.9	187.8	30.9	4.1	128.7	+ 24.1
3521	1862-63	...do		1,500 gm. lean meat, 553.2 gm. oxygen from air.	1	51.0	50.2	0.6	+ 0.2	187.8	30.2	4.1	135.2	+ 18.3
3522	1862-63	...do		1,500 gm. lean meat, 619.4 gm. oxygen from air.	1	51.0	48.6	0.5	+ 1.9	187.8	29.3	3.0	178.9	— 23.4
3523	1862-63	...do		1,500 gm. lean meat, 367.7 gm. oxygen from air.	1	51.0	51.3	0.5	— 0.8	187.8	30.6	3.0	150.3	+ 3.9
3524	1862-63	...do		...do	1	51.0	52.4	0.4	— 1.8	187.8	31.5	3.0	146.6	+ 6.7
3525	1869	Dog		Fasting; 33 gm. water, 358.1 gm. oxygen from air.	1	0.0	6.0	0.0	— 6.0	0.0	4.2	0.0	99.9	—104.1
3526	1869	...do		Fasting; 125 gm. water, 302.0 gm. oxygen from air.	1	0.0	5.2	0.0	— 5.2	0.0	3.9	0.0	78.9	— 82.8
3527	1869	...do		Fasting; 123 gm. water, 370.7 gm. oxygen from air.	1	0.0	11.6	0.0	—11.6	0.0	5.0	0.0	103.7	—108.7
3528	1869	...do		Fasting; 25 gm. water, 358.0 gm. oxygen from air.	1	0.0	5.7	0.0	— 5.7	0.0	2.5	0.0	97.5	—100.0
3529	1869	...do		Fasting; 15 gm water, 335.3 gm. oxygen from air.	1	0.0	4.7	0.0	— 4.7	0.0	2.0	0.0	91.2	— 93.2
3530	1869	...do		100 gm. fat, 214 gm. water, 262.2 gm. oxygen from air.	1	0.0	5.0	0.4	— 5.4	76.5	4.0	5.5	82.3	— 15.3
3531	1869	...do		100 gm. fat, 158 gm. water, 226.4 gm. oxygen from air.	1	0.0	4.0	0.4	— 4.4	76.5	3.2	5.5	85.0	— 17.2
3532	1869	...do		350 gm. fat, 358 gm. water, 522.3 gm. oxygen from air.	1	0.0	6.8	0.9	— 7.7	267.7	2.9	9.5	141.7	+113.6
3533	1871	Dog		500 gm. lean meat, 351.1 gm. oxygen from air.	1	17.0	23.7	0.3	— 7.0	62.6	14.3	2.2	107.2	— 61.1
3534	1871	...do		500 gm. lean meat, 379.8 gm. oxygen from air.	1	17.0	20.9	0.3	— 4.2	62.6	12.6	2.2	103.2	— 55.4
3535	1871	...do		500 gm. lean meat, 332.3 gm. oxygen from air.	1	17.0	19.4	0.3	— 2.7	62.6	11.7	2.2	100.2	— 51.5
3536	1871	...do		500 gm. lean meat, 351.6 gm. oxygen from air.	1	17.0	18.5	0.3	— 1.8	62.6	11.2	2.2	93.8	— 44.6
3537	1871	...do		500 gm. lean meat, 301.0 gm. oxygen from air.	1	17.0	18.9	0.3	— 2.2	62.6	11.4	2.2	89.1	— 40.1
3538	1871	...do		500 gm. lean meat, 330.3 gm. oxygen from air.	1	17.0	18.9	0.3	— 2.2	62.6	11.4	2.2	90.8	— 41.8
3539	1871	...do		1,000 gm. lean meat, 394.2 gm. oxygen from air.	1	34.0	38.6	0.6	— 5.2	125.2	23.3	3.7	129.0	— 30.8
3540	1871	...do		1,000 gm. lean meat, 453.3 gm. oxygen from air.	1	34.0	36.1	0.6	— 2.7	125.2	21.7	3.7	124.4	— 24.6

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3515	Dog	5.4	177.3	175.7	+ 1.6	10.3	9.3	+ 1.0	5.8	3.5	3.5	+0.8	In dry gall 0.7 gm. N, 5.3 gm. C, 0.7 gm. H, 1.6 gm. O, 0.5 gm. S, 0.8 gm. ash.	Bidder and Schmidt.
3516	Dog	30	1,736.9	1,833.7	— 96.7	152.4	181.7	—29.3	19.5	16.5	3.3	—0.3		Pettenkofer and Voit.
3517	....do		1,465.8	1,544.6	— 78.8	152.4	150.0	+ 2.4	19.5	15.5	3.8	+0.2		Do.
3518	....do		1,396.8	1,321.8	+ 75.0	152.4	128.2	+24.2	19.5	15.6	2.8	+1.1		Do.
3519	....do		1,512.8	1,523.8	— 11.0	152.4	147.9	+ 4.5	19.5	16.3	2.8	+0.4		Do.
3520	....do		1,546.4	1,583.7	— 37.3	152.4	159.0	— 6.6	19.5	16.4	2.8	+0.3		Do.
3521	....do		1,642.4	1,693.8	— 51.4	152.4	170.5	—18.1	19.5	16.1	2.8	+0.6		Do.
3522	....do		1,708.6	1,729.3	— 20.7	152.4	180.6	—28.2	19.5	15.5	2.1	+1.9		Do.
3523	....do		1,643.6	1,566.7	+ 76.9	175.8	160.6	+15.2	19.5	16.4	2.1	+1.0		Do.
3524	....do		1,597.1	1,538.5	+ 58.6	170.8	156.3	+14.4	19.5	16.7	2.1	+0.7		Do.
3525	Dog		387.4	721.7	—334.3									Do.
3526	....do		413.1	638.5	—225.4									Do.
3527	....do		480.0	745.8	—265.8									Do.
3528	....do		380.2	673.6	—293.4									Do.
3529	....do		348.6	533.8	—185.2									Do.
3530	....do		464.0	550.6	— 86.6									Do.
3531	....do		378.5	569.0	—190.5									Do.
3532	....do		881.1	1,186.1	—305.0									Do.
3533	Dog		714.2	989.7	—275.5	50.7	92.7	—42.0	6.5	7.6	1.5	—2.6		Do.
3534	....do		742.8	893.3	—150.5	50.8	80.1	—29.3	6.5	6.7	1.5	—1.7		Do.
3535	....do		695.4	781.1	— 85.7	50.8	65.8	—15.0	6.5	6.2	1.5	—1.2		Do.
3536	....do		714.7	810.1	— 95.4	50.8	73.1	—22.3	6.5	5.9	1.5	—0.9		Do.
3537	....do		664.1	751.7	— 87.6	50.8	65.8	—15.0	6.5	6.1	1.5	—1.1		Do.
3538	....do		693.4	758.9	— 65.5	50.8	66.1	—15.3	6.5	6.1	1.5	—1.1		Do.
3539	....do		1,120.4	1,333.9	—213.5	101.6	129.0	—27.4	13.0	12.4	2.6	—2.0		Do.
3540	....do		1,179.5	1,366.4	—186.9	101.6	134.9	—33.3	13.0	11.5	2.6	—1.1		Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject.		Food per day.	Duration.	Nitrogen.				Carbon.				
		Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3541	1871	Dog		1,500 gm. lean meat, 514.0 gm. oxygen from air.	1	51.0	39.8	0.7	+10.5	187.8	24.3	4.9	164.4	— 5.8
3542	1871	do		1,500 gm. lean meat, 514.8 gm. oxygen from air.	1	51.0	49.8	0.7	+ 0.5	187.8	30.0	4.9	151.3	+ 1.6
3543	1871	do		1,500 gm. lean meat, 485.2 gm. oxygen from air.	1	51.0	51.6	0.7	— 1.4	187.8	31.1	4.9	149.3	+ 2.5
3544	1871	do		1,500 gm. lean meat, 478.1 gm. oxygen from air.	1	51.0	50.3	0.7	0.0	187.8	32.2	4.9	149.1	+ 1.6
3545	1871	do		1,500 gm. lean meat, 468.5 gm. oxygen from air.	1	51.0	51.5	0.7	— 1.2	187.8	31.0	4.9	145.5	+ 6.4
3546	1871	do		1,500 gm. lean meat, 454.3 gm. oxygen from air.	1	51.0	49.4	0.6	+ 1.0	187.8	29.7	3.8	151.2	+ 3.1
3547	1871	do		1,500 gm. lean meat, 437.0 gm. oxygen from air.	1	51.0	49.9	0.6	+ 0.5	187.8	30.1	3.8	141.6	+ 12.3
3548	1871	do		1,500 gm. lean meat, 465.3 gm. oxygen from air.	1	51.0	49.5	0.6	+ 0.9	187.8	29.8	3.8	143.9	+ 10.3
3549	1871	do		1,500 gm. lean meat, 260 gm. water, 455.6 gm. oxygen from air.	1	51.0	52.0	0.7	— 1.7	187.8	31.3	4.7	148.9	+ 2.9
3550	1871	do		1,500 gm. lean meat, 273 gm. water, 535.0 gm. oxygen from air.	1	51.0	55.3	0.7	— 5.0	187.8	33.3	4.7	159.9	— 10.1
3551	1871	do		1,500 gm. lean meat, 353.7 gm. oxygen from air.	1	51.0	41.1	0.5	+ 9.4	187.8	24.7	3.4	143.4	+ 44.4
3552	1871	do		1,500 gm. lean meat, 454.7 gm. oxygen from air.	1	51.0	50.8	0.5	— 0.3	187.8	30.6	3.4	134.8	+ 19.0
3553	1871	do		1,500 gm. lean meat, 476.4 gm. oxygen from air.	1	51.0	51.4	0.5	— 0.9	187.8	30.9	3.4	134.5	+ 19.0
3554	1871	do		1,800 gm. meat, 592.3 gm. oxygen from air....	1	61.2	59.1	0.6	+ 1.5	225.4	35.6	4.3	179.0	+ 6.5
3555	1871	do		2,000 gm. meat, 508.1 gm. oxygen from air....	1	68.0	66.5	0.8	+ 0.7	250.4	40.0	5.4	158.3	+ 46.7
3556	1871	do		2,000 gm. meat, 200 gm. water, 525.8 gm. oxygen from air.	1	68.0	70.9	0.8	— 3.7	250.4	42.7	5.3	171.2	+ 31.2
3557	1871	do		2,500 gm. meat, 668 gm. water, 688.1 gm. oxygen from air.	1	85.0	84.4	1.0	— 0.4	313.0	50.8	6.7	213.6	+ 41.9
3558	1873	Dog		400 gm. meat, 200 gm. fat, 578 gm. water, 585.7 gm. oxygen from air.	1	13.6	14.6	0.7	— 1.7	203.1	8.8	8.3	161.1	+ 24.9
3559	1873	do		500 gm. meat, 100 gm. fat, 375.5 gm. oxygen from air.	1	17.0	16.4	0.3	+ 0.3	139.1	9.8	3.6	98.6	+ 27.1
3560	1873	do		500 gm. meat, 200 gm. fat, 299.4 gm. oxygen from air.	1	17.0	17.5	0.8	— 1.3	215.6	10.5	8.6	116.6	+ 79.9
3561	1873	do		500 gm. meat, 200 gm. fat, 105 gm. water, 274.8 gm. oxygen from air.	1	17.0	16.9	0.8	— 0.7	215.6	10.2	8.6	120.0	+ 76.8
3562	1873	do		500 gm. meat, 200 gm. fat, 449.2 gm. oxygen from air.	1	17.0	15.1	0.8	+ 1.1	215.6	9.1	8.6	141.8	+ 56.1
3563	1873	do		500 gm. meat, 200 gm. fat, 186.9 gm. oxygen from air.	1	17.0	17.0	0.8	— 0.8	215.6	9.9	8.6	136.7	+ 60.5
3564	1873	do		500 gm. meat, 200 gm. fat, 370 gm. water, 374.0 gm. oxygen from air.	1	17.0	17.5	0.8	— 1.3	215.6	10.5	8.6	133.4	+ 63.1
3565	1873	do		800 gm. meat, 350 gm. fat, 453 gm. water, 584.5 gm. oxygen from air.	1	27.2	21.1	0.5	+ 5.6	367.9	12.7	7.5	163.1	+184.6

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3541	Dog	......	1,603.2	1,724.9	—121.7	152.4	165.6	—13.2	19.5	12.7	3.4	+3.4	......	Pettenkofer and Voit.
3542	....do	......	1,604.0	1,602.1	+ 1.9	152.4	153.8	— 1.4	19.5	15.9	3.4	+0.2	......	Do.
3543	....do	......	1,574.4	1,637.9	— 63.5	152.4	162.8	—10.4	19.5	16.5	3.4	—0.4	......	Do.
3544	....do	......	1,567.3	1,573.3	— 6.0	152.4	153.1	— 0.7	19.5	16.1	3.4	0.0	......	Do.
3545	....do	......	1,557.1	1,579.3	— 21.6	152.4	153.7	— 1.3	19.5	16.5	3.4	—0.4	......	Do.
3546	....do	......	1,543.5	1,650.2	—106.7	152.4	159.7	— 7.3	19.5	15.8	2.6	+1.1	......	Do.
3547	....do	......	1,526.2	1,602.3	— 76.1	152.4	156.9	— 4.5	19.5	16.0	2.6	+0.9	......	Do.
3548	....do	......	1,554.5	1,584.1	— 29.6	152.4	153.9	— 1.5	19.5	15.8	2.7	+1.0	......	Do.
3549	....do	......	1,775.9	1,850.3	— 74.4	181.3	187.9	— 6.6	19.5	16.6	3.3	—0.4	......	Do.
3550	....do	......	1,866.9	2,041.0	—174.1	182.7	209.2	—26.5	19.5	17.7	3.2	—1.4	......	Do.
3551	....do	......	1,442.9	1,223.1	+219.8	152.4	118.5	+33.9	19.5	13.2	2.3	+4.0	......	Do.
3552	....do	......	1,543.9	1,536.5	+ 7.5	152.4	151.0	+ 1.4	19.5	16.3	2.3	+0.9	......	Do.
3553	....do	......	1,565.6	1,559.1	+ 6.5	152.4	155.1	— 2.7	19.5	16.5	2.3	+0.7	......	Do.
3554	....do	......	1,899.4	2,055.9	—156.5	182.9	201.9	—19.0	23.4	18.9	3.0	+1.5	......	Do.
3555	....do	......	1,960.4	1,950.7	+ 9.7	203.3	196.6	+ 6.7	26.0	21.3	3.7	+1.0	......	Do.
3556	....do	......	2,155.9	2,159.3	— 3.4	225.5	218.3	+ 7.2	26.0	22.7	3.7	—0.4	......	Do.
3557	....do	......	3,097.3	3,141.3	— 44.0	328.3	327.9	+ 0.4	32.5	27.0	4.6	+0.9	......	Do.
3558	Dog	......	1,413.2	1,490.6	— 77.4	128.6	134.7	— 6.1	5.2	4.7	3.1	—2.6	......	Do.
3559	....do	......	750.2	800.1	— 49.9	62.7	71.8	— 9.1	6.5	5.2	1.5	—0.2	......	Do.
3560	....do	......	685.6	997.1	—311.5	74.6	96.3	—21.6	6.5	5.6	1.9	—1.0	......	Do.
3561	....do	......	754.4	1,143.9	—389.5	86.3	111.7	—25.4	6.5	5.4	1.9	—0.9	......	Do.
3562	....do	......	835.4	1,088.0	—252.5	74.6	105.7	—31.1	6.5	4.9	1.9	—0.3	......	Do.
3563	....do	......	573.1	1,180.1	—606.9	74.6	111.1	—36.4	6.5	5.2	1.9	—0.7	......	Do.
3564	....do	......	1,089.2	1,232.8	—143.6	115.7	119.4	— 3.7	6.5	5.6	1.9	—1.0	......	Do.
3565	....do	......	1,608.7	1,509.6	+ 99.1	173.3	136.7	+36.6	10.4	6.7	2.5	+1.2	......	Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject.		Food per day.	Duration.	Nitrogen.				Carbon.				
		Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3566	1873	Dog	....	1,500 gm. meat, 30 gm. fat, 400 gm. oxygen from air.	1	51.0	48.8	0.6	+ 1.6	210.7	29.4	5.0	147.0	+ 29.4
3567	1873	....do	....	1,500 gm. meat, 30 gm. fat, 475 gm. oxygen from air.	1	51.0	49.1	0.6	+ 1.3	210.7	29.6	5.0	145.3	+ 30.9
3568	1873	....do	....	1,500 gm. meat, 60 gm. fat, 503.4 gm. oxygen from air.	1	51.0	50.2	0.8	0.0	233.7	30.2	7.6	165.8	+ 30.1
3569	1873	....do	....	1,500 gm. meat, 100 gm. fat, 432.7 gm. oxygen from air.	1	51.0	46.1	0.6	+ 4.3	264.3	27.8	6.9	141.0	+ 88.6
3570	1873	....do	....	1,500 gm. meat, 100 gm. fat, 480.1 gm. oxygen from air.	1	51.0	48.0	0.6	+ 2.4	264.3	28.9	6.9	153.2	+ 75.3
3571	1873	....do	....	1,500 gm. meat, 100 gm. fat, 397.3 gm. oxygen from air.	1	51.0	48.8	0.5	+ 1.7	264.3	29.4	5.6	139.4	+ 89.9
3572	1873	....do	....	1,500 gm. meat, 150 gm. fat, 564.4 gm. oxygen from air.	1	51.0	49.3	0.7	+ 1.0	302.5	29.7	9.0	153.6	+110.3
3573	1873	....do	....	1,500 gm. meat, 150 gm. fat, 478.7 gm. oxygen from air.	1	51.0	48.2	0.7	+ 2.1	302.5	29.0	9.0	155.9	+108.6
3574	1873	....do	....	400 gm. meat, 250 gm. starch, 10.2 gm. fat, 390 gm. water, 439.7 gm. oxygen from air.	1	13.6	14.4	0.5	— 1.3	151.4	8.7	4.8	148.6	— 10.7
3575	1873	....do	....	400 gm. meat, 250 gm. grape sugar, 350 gm. water, 434.7 gm. oxygen from air.	1	13.6	12.6	0.8	+ 0.2	141.0	7.6	5.4	146.6	— 18.6
3576	1873	....do	....	400 gm. meat, 400 gm. starch, 5.6 gm. fat, 385.4 gm. water, 467.5 gm. oxygen from air.	1	13.6	13.3	0.8	— 0.5	207.1	8.9	7.9	157.5	+ 32.8
3577	1873	....do	....	500 gm. meat, 200 gm. starch, 5.6 gm. fat, 144 gm. water, 171.1 gm. oxygen from air.	1	17.0	19.7	0.3	— 3.0	141.1	13.2	3.8	115.6	+ 8.5
3578	1873	....do	....	500 gm. meat, 200 gm. starch, 4.0 gm. fat, 159 gm. water, 393.2 gm. oxygen from air.	1	17.0	19.5	0.3	— 2.8	139.9	13.1	3.8	111.9	+ 11.1
3579	1873	....do	....	500 gm. meat, 200 gm. starch, 5.4 gm. fat, 141 gm. water, 265.8 gm. oxygen from air.	1	17.0	18.0	0.3	— 1.3	140.9	12.1	3.8	111.2	+ 13.8
3580	1873	....do	....	500 gm. meat, 200 gm. starch, 5.5 gm. fat, 147 gm. water, 262.8 gm. oxygen from air.	1	17.0	18.9	0.3	— 2.2	141.0	12.7	3.8	112.1	+ 12.4
3581	1873	....do	....	500 gm. meat, 200 gm. starch, 5.0 gm. fat, 169 gm. water, 282 gm. oxygen from air.	1	17.0	18.9	0.3	— 2.2	140.6	12.7	3.8	116.3	+ 7.8
3582	1873	....do	....	500 gm. meat, 200 gm. grape sugar, 368.8 gm. oxygen from air.	1	17.0	17.7	0.4	— 1.1	135.3	11.9	3.6	146.8	— 27.0
3583	1873	....do	....	500 gm. meat, 200 gm. grape sugar, 215.9 gm. oxygen from air.	1	17.0	18.8	0.4	— 2.2	135.3	12.6	3.6	109.9	+ 9.2

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3566	Dog	......	1,492.7	1,530.2	— 37.5	156.0	146.9	+ 9.1	19.5	15.6	2.7	+1.2	....	Pettenkofer and Voit.
3567	.....do	......	1,568.6	1,554.3	+ 14.3	156.0	149.8	+ 6.2	19.5	15.7	2.7	+1.1	....	Do.
3568	.....do	......	1,599.6	1,717.3	—117.7	159.6	172.3	—12.8	19.5	16.1	3.7	—0.3	....	Do.
3569	.....do	......	1,533.5	1,501.2	+ 32.4	164.3	147.0	+17.3	19.5	14.7	2.9	+1.9	....	Do.
3570	.....do	......	1,580.9	1,605.1	— 24.2	164.3	153.6	+10.7	19.5	15.3	2.9	+1.3	....	Do.
3571	.....do	......	1,498.1	1,479.4	+ 18.7	164.3	144.4	+19.9	19.5	15.6	2.3	+1.5	....	Do.
3572	.....do	......	1,670.9	1,641.7	+ 29.2	170.3	161.0	+ 9.3	19.5	15.8	3.2	+0.5	....	Do.
3573	.....do	......	1,585.2	1,634.1	— 48.9	170.3	159.8	+10.6	19.5	15.4	3.2	+0.9	....	Do.
3574	.....do	......	1,217.1	1,314.0	— 96.9	102.6	116.0	—13.4	5.2	4.6	1.4	—0.8	....	Do.
3575	.....do	......	1,177.7	1,280.1	—102.4	97.2	112.6	—15.4	5.2	4.0	3.8	—2.6	....	Do.
3576	.....do	......	1,321.0	1,344.8	— 23.8	111.6	122.8	—11.2	5.2	4.4	1.7	—0.9	....	Do.
3577	.....do	......	774.7	815.7	— 41.0	81.5	65.6	+15.9	6.5	6.6	1.8	—1.9	....	Do.
3578	.....do	......	1,009.9	951.9	+ 58.0	83.0	83.7	— 0.7	6.5	6.5	1.8	—1.8	....	Do.
3579	.....do	......	866.6	805.0	+ 61.6	81.1	65.5	+15.6	6.5	6.0	1.8	—1.3	....	Do.
3580	.....do	......	869.0	833.0	+ 36.0	81.8	68.8	+13.0	6.5	6.3	1.8	—1.6	....	Do.
3581	.....do	......	909.7	913.9	— 6.2	84.2	77.4	+ 6.8	6.5	6.3	1.8	—1.6	....	Do.
3582	.....do	......	845.0	919.4	— 74.4	65.0	67.9	— 2.9	6.5	5.9	2.3	—1.7	....	Do.
3583	.....do	......	692.1	741.2	— 49.1	65.0	58.0	+ 7.0	6.5	6.3	2.3	—2.1	....	Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Carbon. In food.	Carbon. In urine.	Carbon. In feces.	Carbon. In respiratory products.	Carbon. Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3584	1873	Dog		500 gm. meat, 200 gm. grape sugar, 233.7 gm. oxygen from air.	1	17.0	17.4	0.4	— 0.8	135.3	11.7	3.6	114.5	+ 5.5
3585	1873	....do		500 gm. meat, 200 gm. grape sugar, 202.2 gm. oxygen from air.	1	17.0	17.6	0.4	— 1.0	135.3	11.8	3.6	112.9	+ 7.0
3586	1873	....do		500 gm. meat, 200 gm. starch, 6.7 gm. fat, 144.5 gm. water, 305 gm. oxygen from air.	1	17.0	19.6	0.3	— 2.9	141.9	13.1	4.3	116.6	+ 7.9
3587	1873	....do		500 gm. meat, 200 gm. starch, 5.5 gm. fat, 164.3 gm. water, 240.9 gm. oxygen from air.	1	17.0	16.2	0.3	+ 0.5	141.0	10.9	4.3	119.5	+ 6.3
3588	1873	....do		500 gm. meat. 200 gm. starch, 4.8 gm. fat, 197.2 gm. water, 258.7 gm. oxygen from air.	1	17.0	17.2	0.3	— 0.5	140.5	11.5	4.3	120.3	+ 4.4
3589	1873	....do		800 gm. meat, 450 gm. starch, 13.7 gm. fat, 339.0 gm. water, 472.2 gm. oxygen from air.	1	27.2	20.0	0.7	+ 6.5	279.0	14.2	7.4	180.9	+ 76.5
3590	1873	....do		1,500 gm. meat, 200 gm. starch, 5.2 gm. fat, 519.6 gm. water, 759.5 gm. oxygen from air.	1	51.0	48.6	1.2	+ 1.1	268.2	30.7	8.9	236.4	— 7.9
3591	1873	....do		1,500 gm. meat, 200 gm. starch, 3.8 gm. fat, 155.9 gm. water, 561.5 gm. oxygen from air.	1	51.0	48.9	1.2	+ 0.8	267.1	30.9	8.9	185.1	+ 42.2
3592	1873	....do		1,800 gm. meat, 450 gm. starch, 10.1 gm. fat, 701.0 gm. water, 611.2 gm. oxygen from air.	1	61.2	49.3	0.6	+11.3	401.5	31.1	6.3	229.3	+134.7
3593	1873	....do		450 gm. starch, 16.9 gm. fat, 405.0 gm. water, 429.6 gm. oxygen from air.	1	0.0	6.4	0.8	— 7.2	181.3	4.5	8.6	148.8	+ 19.4
3594	1873	....do		700 gm. starch, 14.1 gm. fat	1	1.0	5.9	0.5	— 5.4	271.7	4.2	8.5	189.6	+ 64.4
3595	1873	....do		700 gm. starch, 17.0 gm. fat	1	1.0	6.4	1.1	— 6.5	273.9	4.6	17.3	149.2	+102.8
3596	1873	....do		700 gm. starch, 22.3 gm. fat	1	1.0	5.1	2.5	— 6.6	285.8	3.6	51.5	214.1	+ 16.6
3597	1873	....do		597 gm. starch, 21.2 gm. fat	1	0.9	8.2	2.1	— 9.4	237.8	5.8	42.5	218.0	— 28.5
3598	1873	....do		800 gm. bread, 963 gm. water, 448.9 gm. oxygen from air.	1	10.2	9.9	2.0	— 1.7	194.9	7.2	32.6	158.2	— 3.1
3599	1873	....do		900 gm. bread, 964 gm. water, 477.9 gm. oxygen from air.	1	11.6	10.9	2.0	— 1.3	220.4	8.0	32.3	179.6	+ 0.5
3600	1873	....do		900 gm. bread, 853 gm. water, 522.2 gm. oxygen from air.	1	11.6	11.7	2.0	— 2.1	220.4	7.3	32.3	164.6	+ 16.2
3601	1883	Dog		Fasting	1	0.0	1.5	0.2	— 1.7	0.0	1.1	1.4	53.6	— 56.1
3602	1883	....do		....do	1	0.0	1.5	0.2	— 1.7	0.0	1.1	1.4	49.6	— 52.1
3603	1883	Dog	6.0	....do	3	0.0	2.5	0.1	— 2.6	....	....	....	....	....

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3584	Dog		709.9	925.7	—215.8	65.0	79.4	—14.4	6.5	5.8	2.3	—1.6		Pettenkofer and Voit.
3585	do		678.4	855.1	—176.7	65.0	71.2	— 6.2	6.5	5.9	2.3	—1.7		Do.
3586	do		909.1	991.7	— 82.6	81.7	96.5	—14.8	6.5	6.6	2.0	—2.1		Do.
3587	do		862.5	876.9	— 14.4	83.7	80.0	+ 3.7	6.5	5.4	2.0	—0.9		Do.
3588	do		909.5	924.9	— 15.5	87.3	87.0	+ 0.3	6.5	5.8	2.0	—1.3		Do.
3589	do		1,606.3	1,648.7	— 42.4	151.9	147.9	+ 4.0	10.4	6.4	2.2	+1.8		Do.
3590	do		2,421.1	2,376.3	+ 44.8	224.6	223.1	+ 1.5	19.5	15.5	3.7	+0.3		Do.
3591	do		1,899.6	2,059.9	—160.3	184.0	209.1	—25.1	19.5	15.6	3.7	+0.2		Do.
3592	do		2,792.9	2,568.4	+224.5	293.4	249.0	+44.4	23.4	15.8	1.9	+5.7		Do.
3593	do		1,041.9	1.260.7	—218.8	78.3	108.9	—30.6	0.0	2.0	2.6	—4.6		Do.
3594	do													Do.
3595	do													Do.
3596	do													Do.
3597	do													Do.
3598	do		1,813.2	1,528.3	+284.9	175.9	140.3	+35.6	17.7	10.9	4.8	+2.0		Do.
3599	do		1,905.5	1,833.9	+ 71.6	184.5	172.3	+12.2	20.0	12.4	4.6	+3.0		Do.
3600	do		1,851.2	1,920.3	— 69.1	172.1	195.6	—23.5	20.0	12.7	4.6	+2.7		Do.
3601	Dog													Rubner.
3602	do													Do.
3603	Dog	6.0												Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Carbon. In food.	Carbon. In urine.	Carbon. In feces.	Carbon. In respiratory products.	Carbon. Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3604	1883	Dog		Fasting	1	0.0	2.4	0.2	— 2.6	0.0	1.8	1.4	38.3	— 41.5
3605	1883	Dog (female)		...do	1	0.0	2.7	0.1	— 2.8	0.0	2.1	0.3	70.3	— 72.7
3606	1885	Dog	20.3	...do	2	0.0	3.7	0.1	— 3.8	0.0	2.7	1.3	77.5	— 81.5
3607	1885	...do	20.3	...do	2	0.0	3.4	0.1	— 3.5	0.0	2.5	1.3	70.3	— 74.1
3608	1885	...do		...do		0.0	3.6	0.1	— 3.7	0.0	2.6	1.3	73.6	— 77.5
3609	1886	Dog (female)	6.2	...do	2	0.0	3.1	0.1	— 3.2	0.0	2.3	0.6	27.6	— 30.5
3610	1886	...do		100 gm. cane sugar, 85 gm. starch, 4.7 gm. fat.	1	0.0	1.7	0.1	— 1.8	84.1	1.3	0.6	35.6	+ 46.6
3611	1886	...do		...do	1	0.0	0.7	0.1	— 0.8	84.1	0.6	0.6	39.3	+ 43.6
3612	1844	Dove	0.2	15.3 gm. millet	5	0.4	0.3		+ 0.1	6.1	1.2		4.9	0.0
3613	1844	...do		16.8 gm. millet	7	0.5	0.3		+ 0.2	6.7	1.4		5.3	0.0
3614	1844	...do		Fasting	7	0.0	0.1		— 0.1	0.0	0.1		2.4	— 2.5
3615	1882	Rooster	1.9	Fasting; 20 gm. water	3	0.0	2.8		— 2.8	0.0	3.3		8.9	— 12.2
3616	1882	Hen	1.0	...do	6	0.0	0.9		— 0.9	0.0	1.0		7.1	— 8.1
3617	1894	Horse	432.0	4,000 gm. oats, 1,880 gm. meadow hay, 800 gm. oat straw.	1	89.7	51.0	26.2	+12.5	2,946.7	89.2	1,224.8	1,309.2	+323.5
3618	1849	Rabbit	3.6	500 gm. carrots, 75 gm. oxygen from air	1	1.0	0.4		+ 0.6	26.0	2.1		23.9	0.0
3619	1885	Rabbit		500 cc. milk, 5 gm. horn shavings, 50 cc. water.	9	3.4	3.0	1.0	— 0.6	35.3	2.5	5.7	31.6	— 4.5
3620	1885	...do		500 cc. milk, 5 gm. horn shavings, 22 gm. crude fiber, 50 cc. water.	8	3.5	2.3	1.1	+ 0.1	44.1	2.6	8.5	31.7	+ 1.3
3621	1885	...do		500 cc. milk, 5 gm. horn shavings, 50 cc. water.	7	3.4	2.7	0.8	— 0.1	36.1	2.6	5.6	33.7	— 4.2
3622	1885	...do		500 cc. milk, 5 gm. horn shavings, 11 gm. sugar.	4	3.4	2.5	1.2	— 0.3	40.9	3.2	6.5	34.6	— 3.4
3623	1885	...do		500 cc. milk, 5 gm. horn shavings, 33 gm. sugar.	3	3.4	2.3	0.8	+ 0.3	50.5	3.4	4.4	37.2	— 5.5
3624	1885	...do		300 cc. milk, 3 gm. horn shavings, 25 cc. water.	6	2.3	1.9	0.6	— 0.2	19.1	1.1	2.7	18.7	— 3.4
3625	1885	...do		300 cc. milk, 3 gm. horn shavings, 25 cc. water, 4 gm. lard.	4	2.3	2.0	0.7	— 0.4	22.1	1.7	3.3	19.1	— 2.0
3626	1885	...do		15 gm. albumen, 1.5 gm. meat extract, 3.0 gm. horn shavings, 0.3 gm. hay ash, 10 gm. sugar, 250 cc. water.	5	2.4	2.4	1.1	— 1.1	12.7	2.2	4.2	13.1	— 6.8
3627	1885	...do		15 gm. albumen, 1.5 gm. meat extract, 3.0 gm. horn shavings, 0.3 gm. hay ash, 10 gm. crude fiber from cabbage leaf, 10 gm. sawdust, 250 cc. water.	4	2.2	3.4	0.9	— 2.1	14.4	3.6	8.3	10.6	— 8.1

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm*	*Gm.*	*Gm.*	*Gm.*		
3604	Dog													Rubner.
3605	Dog (female)													Do.
3606	Dog	20.0											Hot bath	Simanowsky.
3607	.....do	20.0												Do.
3608	.....do												Average of Nos. 3606, 3607	Do.
3609	Dog (female)	6.2												Rubner.
3610	.....do													Do.
3611	.....do													Do.
3612	Dove	0.2							0.3		0.4	—0.1		Boussingault.
3613	.....do								0.4		0.4	0.0		Do.
3614	.....do													Do.
3615	Rooster	1.9												Kuchein.
3616	Hen	1.0												Do.
3617	Horse	432.0												Lehmann, Hagemann, and Zuntz.
3618	Rabbit		101.3	101.3	0.0	3.7	3.7	0.0	2.9		2.9	0.0		Regnault and Reiset (Bidder and Schmidt).
3619	Rabbit													Knieriem.
3620														Do.
3621	.....do													Do.
3622	.....do													Do.
3623	.....do													Do.
3624	.....do													Do.
3625	.....do													Do.
3626	.....do													Do.
3627	.....do													Do.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject. Kind of animal.	Subject. Weight.	Food per day.	Duration.	Nitrogen. In food.	Nitrogen. In urine.	Nitrogen. In feces.	Nitrogen. Gain (+) or loss (—).	Carbon. In food.	Carbon. In urine.	Carbon. In feces.	Carbon. In respiratory products.	Carbon. Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3628	1885	Rabbit	....	15 gm. albumen, 1.5 gm. meat extract, 3 gm. horn shavings, 0.3 gm. hay ash, 10 gm. sugar, 250 cc. water.	4	2.4	2.3	0.2	—0.1	12.7	2.3	2.4	11.3	— 3.3
3629	1894	Rabbit	....	Fasting	3	0.0	1.5	0.0	—1.5	0.0	1.4	0.0	13.2	—14.6
3630	1894	.....do	....	.....do	2	0.0	2.1	0.0	—2.1	0.0	1.7	0.0	13.8	—15.5
3631	1894	.....do	....	30 gm. grape sugar	1	0.0	0.1	0.0	—0.1	....	....	....	....	....
3632	1894	Rabbit	....	Fasting	5	0.0	2.0	0.0	—2.0	0.0	1.5	0.0	13.1	—14.6
3633	1894	.....do	....	.....do	2	0.0	2.7	0.0	—2.7	0.0	2.1	0.0	14.2	—16.3
3634	1894	.....do	....	.....do	4	0.0	1.3	0.0	—1.3	0.0	1.2	0.0	17.7	—18.9
3635	1894	.....do	....	.....do	2	0.0	1.5	0.0	—1.5	0.0	1.3	0.0	15.2	—16.5
3636	1894	.....do	....	42.8 gm. grape sugar, 120 cc. water	1	0.0	0.8	0.0	—0.8	17.1	0.7	0.0	15.6	+ 0.8
3637	1894	Rabbit	....	Fasting	4	0.0	1.4	0.0	—1.4	....	....	....	....	....
3638	1894	.....do	....	.....do	4	0.0	1.4	0.0	—1.4	0.0	1.3	0.0	10.8	—12.1
3639	1894	.....do	....	30 gm. grape sugar, 100 cc. water	1	0.0	1.2	0.0	—1.2	12.0	1.0	0.0	13.0	— 2.0
3640	1894	Rabbit	....	Fasting	3	0.0	2.3	0.0	—2.3	0.0	1.7	0.0	9.2	—10.9
3641	1894	.....do	....	.....do	1	0.0	2.8	0.0	—2.8	0.0	2.2	0.0	11.5	—13.7
3642	1894	.....do	....	30 gm. grape sugar, 100 cc. water	1	0.0	2.4	0.0	—2.4	12.0	1.9	0.0	13.9	— 2.8
3643	1894	.....do	....	.....do	2	0.0	1.5	0.0	—1.5	....	....	....	....	....
3644	1894	.....do	....	.....do	2	0.0	2.0	0.0	—2.0	0.0	1.9	0.0	19.9	—21.8
3645	1894	.....do	....	30 gm. grape sugar, 100 cc. water	1	0.0	1.3	0.0	—1.3	12.0	1.0	0.0	17.1	— 6.1
3646	1894	Rabbit	....	Fasting	2	0.0	1.6	0.0	—1.6	....	....	....	....	....
3647	1894	.....do	....	.....do	2	0.0	2.2	0.0	—2.2	0.0	1.9	0.0	16.9	—18.8
3648	1870	Sheep (average of III and IV).	47.8	1,216 gm. meadow hay, 6 gm. salt, 1,714.5 gm. water, 587.6 gm. oxygen from air.	8	18.1	7.7	8.5	+1.9	460.2	23.3	202.5	213.9	+20.5
3649	1870	.....do	48.0	1,146.5 gm. meadow hay, 6 gm. salt, 1,764.5 gm. water, 575.3 gm. oxygen from air.	8	17.6	7.6	8.0	+2.0	438.6	22.1	191.4	209.4	+15.7
3650	1870	.....do	47.9	1,181.3 gm. meadow hay, 6 gm. salt, 1,739.5 gm. water, 581.4 gm. oxygen from air.	......	17.8	7.6	8.2	+2.0	449.4	22.7	196.9	211.6	+18.2
3651	1873	Sheep	....	750 gm. hay, 200 gm. barley meal	6	13.3	7.3	5.2	—0.8	371.4	15.6	133.8	185.1	+36.9

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3628	Rabbit													Knieriem.
3629	Rabbit												No fever. Respiration experiment was of 1 day's duration.	May.
3630	do												Fever	Do.
3631	do												No fever	Do.
3632	Rabbit												No fever. Respiration experiment was of 3 days' duration.	Do.
3633	do												Fever	Do.
3634	do												No fever	Do.
3635	do												Fever	Do.
3636	do												No fever	Do.
3637	Rabbit												do	Do.
3638	do												No fever. Respiration experiment was of 1 day's duration.	Do.
3639	do												No fever	Do.
3640	Rabbit												No fever. Respiration experiment was of 1 day's duration.	Do.
3641	do												Fever	Do.
3642	do												do	Do.
3643	do												No fever	Do.
3644	do												Fever. Respiration experiment was of 1 day's duration.	Do.
3645	do												Fever	Do.
3646	Rabbit												No fever	Do.
3647	do												Fever. Respiration experiment was of 1 day's duration.	Do.
3648	Sheep (average of III and IV).	47.8	2,694.4	2,655.0	+39.4	276.2	268.8	+7.4	75.2	31.2	44.0	0.0		Henneberg and associates.
3649	do	48.0	2,688.3	2,628.1	+60.2	276.3	267.1	+9.2	71.6	30.7	41.6	—0.7		Do.
3650	do	47.9	2,691.3	2,641.5	+49.8	276.2	268.0	+8.2	73.4	31.0	42.8	—0.4	Average of Nos. 3648, 3649	Do.
3651	Sheep													Henneberg, Fleischer, and Müller.

TABLE 38—PART I.—*Respiration experiments*—Continued.

Serial number.	Date of publication.	Subject.		Food per day.	Duration.	Nitrogen.				Carbon.				
		Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
			Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
3652	1886	Pig	140.0	1,986.4 gm. rice, 10,000 gm. water, 15 gm. salt	6	18.7	10.5	2.1	+6.1	765.4	10.9	12.0	453.3	+289.2
3653	1886	Pig	68.8	2,000 gm. rice, 10,000 gm. water, 10 gm. salt	7	21.8	10.3	3.7	+7.8	785.8	12.0	19.6	415.0	+339.2
3654	1886	Pig	124.1	1,896 gm. barley meal, 10,000 gm. water, 15 gm. salt.	5	29.0	14.1	9.5	+5.4	725.4	13.6	185.1	375.1	+151.2
3655	1886	Pig	102.0	750 gm. rice, 8,000 gm. whey, 400 gm. meat meal.	7	69.9	61.1	1.7	+7.1	672.5	34.7	11.6	409.2	+217.0
3656	1886	Pig	144.0	Fasting	3	0.0	9.8	0.0	—9.8	0.0	7.5	0.0	217.0	—224.5
3657	1886	Pig		do	1	0.0	6.8	0.0	—6.8	0.0	5.0	0.0	194.9	—199.9
3658	1892	Pig	31.5	400 gm. corn cockles, 300 gm. barley, 300 gm. maize, 3 gm. salt, 1 gm. calcium phosphate.	10	18.9	10.3	3.6	+5.0	384.0	9.5	61.3	211.6	+101.6
3659	1892	Pig		Oil cake, barley, maize, 3 gm. salt	10	20.6	10.4	3.9	+6.3	384.9	10.0	55.9	221.1	+ 97.9

TABLE 38—PART II.—*Respiration experiments*—Continued.

Serial number.	Subject.		Oxygen.			Hydrogen.			Ash.				Remarks.	Observer.
	Kind of animal.	Weight.	Total consumed.	Total excreted.	Gain (+) or loss (—).	Total consumed.	Total excreted.	Gain (+) or loss (—).	In food.	In urine.	In feces.	Gain (+) or loss (—).		
		Kg.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*		
3652	Pig	140.0							9.7	4.5	3.0	+2.2		Meissl. Strohmer, and Lorenz.
3653	Pig	68.8							10.2	4.0	4.1	+2.1		
3654	Pig	124.1							42.8	11.3	28.5	+3.0		
3655	Pig	102.0							45.4	36.9	4.5	+4.0		
3656	Pig	144.0							0.0	4.4	0.0	—4.4		
3657	Pig								0.0	3.0	0.0	—3.3		
3658	Pig	31.5											Respiration experiment was of 2 days' duration.	Kornauth and Arche.
3659	Pig												do	

Nos. 3463, 3464. Jour. Landw., 1868, pp. 24. 25. No. 3465. Landw. Vers. Stat., 10, p. 446. Nos. 3466, 3467. Ibid., p. 462. Nos. 3468–3475. Jour. Landw., 1871, pp. 27–30. Neue Beiträge zur Fütterung der Wiederkauer, 2, p. 380. Nos. 3476, 3477. Landw. Vers. Stat., 44, pp. 336, 337. Nos. 3478, 3479. Ibid., p. 367. Nos. 3480–3495. Ibid., pp. 500–503. Nos. 3496–3499. Ibid., 543–545. Nos. 3500–3504. Untersuchungen über den Stoffwechsel des Saugkalbes, Wien, 1878, pp. 20, 25. No. 3505. Ibid., p. 54. No. 3506. Die Verdauungs-Säfte, p. 306. No. 3507. Ibid., p. 314. No. 3508. Ibid., p. 335. No. 3509. Ibid., p. 337. No. 3510. Ibid., p. 339. No. 3511. Ibid., p. 342. No. 3512. Ibid., p. 357. No. 3513. Ibid., p. 373. No. 3514. Ibid., p. 379. No. 3515. Ibid., p. 383. Nos. 3516–3524. Ztschr. Biol., 7, pp. 470–480. No. 3525. Ibid., 5. p. 370. No. 3526. Ibid., p. 373. No. 3527. Ibid., p. 377. Nos. 3528, 3529. Ibid., pp. 379, 380. No. 3530. Ibid., p. 385. No. 3531. Ibid., p. 387. No. 3532. Ibid., p. 391. No. 3533. Ztschr. Biol., 7, p. 440. Nos. 3534, 3535. Ibid., p. 441. No. 3536. Ibid., p. 442. Nos. 3537, 3538. Ibid., p. 443. Nos. 3539, 3540. Ibid., p. 446. Nos. 3541, 3542. Ibid., pp. 450, 451. Nos. 3543, 3544. Ibid., p. 452. No. 3545. Ibid., p. 453. No. 3546. Ibid., p. 459. Nos. 3547, 3548. Ibid., p. 460. Nos. 3549, 3550. Ibid., pp. 467, 468. No. 3551. Ibid., p. 463. Nos. 3552, 3553. Ibid., p. 464. No. 3554. Ibid., p. 483. Nos. 3555, 3556. Ibid., p. 485. No. 3557. Ibid., p. 488. No. 3558. Ztschr. Biol., 9, p. 3. No. 3559. Ibid., p. 6. No. 3560. Ibid., p. 8. Nos. 3561–3564. Ibid., pp. 10–13. No. 3565. Ibid., p. 16. Nos. 3566, 3567. Ibid., pp. 18, 19. Nos. 3568–3570. Ibid., pp. 21–23. No. 3571. Ibid., p. 25. Nos. 3572, 3573. Ibid., pp. 27, 28. No. 3574. Ibid., p. 440. No. 3575. Ibid., p. 442. No. 3576. Ibid., p. 445. No. 3577. Ibid., p. 450. Nos. 3578–3581. Ibid., pp. 452–455. Nos. 3582, 3583. Ibid., pp. 458, 459. Nos. 3584, 3585. Ibid., pp. 461, 463. Nos. 3586–3588. Ibid., pp. 465–467. No. 3589. Ibid., p. 472. No. 3590. Ibid., p. 474. No. 3591. Ibid., p. 476. No. 3592. Ibid., p. 482. No. 3593. Ibid., p. 486. No. 3594. Ibid., p. 489. No. 3595. Ibid., p. 492. Nos. 3596, 3597. Ibid., pp. 496, 497. No. 3598. Ibid., p. 499. Nos. 3599, 3600. Ibid., pp. 502, 503. Nos. 3601, 3602. Ztschr. Biol., 19, p. 328. No. 3603. Ibid., p. 332. No. 3604. Ibid., p. 334. No. 3605. Ibid., p. 341. Nos. 3606–3608. Ztschr. Biol., 21, p. 17. Nos. 3609–3611. Ztschr. Biol., 22, p. 273. Nos. 3612, 3613. Ann. Chem. et Phys., ser. 3, 11, pp. 439, 445. No. 3614. Ibid., p. 453. No. 3615. Ztschr. Biol., 18, p. 22. No. 3616. Ibid., p. 26. No. 3617. Landw. Jahrb., 1894, p. 143. No. 3618. Die Verdauungs Säfte, p. 367, and Ann. Chim. et Phys., 3. ser., 26, p. 406. Nos. 3619, 3620. Ztschr. Biol., 21, p. 100. Nos. 3621–3623. Ibid., p. 101. Nos. 3624, 3625. Ibid., p. 119. Nos. 3626–3628. Ibid., p. 126. Nos. 3629–3631. Ztschr. Biol., 30, p. 16. Nos. 3632, 3633. Ibid., p. 18. Nos. 3634, 3635. Ibid., p. 20. Nos. 3636, 3637. Ibid., p. 21. Nos. 3638, 3639. Ibid., p. 23. Nos. 3640–3642. Ibid., p. 24. Nos. 3643–3645. Ibid., p. 26. Nos. 3646, 3647. Ibid., p. 27. Nos. 3648, 3649. Jour. Landw., 1870, p. 185. No. 3650. Ibid., p. 189. No. 3651. Jahresber. agr. Chem., 16, 17, p. 147. No. 3652. Ztschr. Biol., 22, p. 84. No. 3653. Ibid., p. 92. No. 3654. Ibid., p. 97. No. 3655. Ibid., p. 103. No. 3656. Ibid., p. 106. No. 3657. Ibid., p. 111. Nos. 3658, 3659. Landw. Vers. Stat., 40, p. 187.

Nos. 3463 and 3464 were made by Henneberg at the experiment station at Weende in 1865, and are referred to by him in a discussion of the objects sought and methods followed in experiments with animals carried on by the experiment stations. The experiments are very likely duplicates of Nos. 3474 and 3468 with the calculated balance of carbon, oxygen, and hydrogen added. The slight discrepancy in the figures for nitrogen is due to the fact that in the original the quantities were given in pounds, and in Nos. 3463 and 3464 there is one less decimal place quoted than in Nos. 3474 and 3468. This caused some variation when the figures were reduced to grams before adding them to this compilation. In No. 3464 the value for nitrogen in the food as given by the author was incorrect but was corrected by the compilers from a later publication[1] where a report of the experiment is given in detail.

Nos. 3465–3467. The data quoted in the table are calculations made by Henneberg based on previous experiments. The object was to compare the metabolism of a steer on a diet containing gluten with that on a maintenance ration of clover hay and oat straw.

Nos. 3468–3475 were made by Henneberg, Busse, Schultz, Kühn, Maercker, Schulze, and Schultze at the experiment station at Weende in 1865. They form part of an extended series of observations on the feeding of full-grown steers. The food consisted of clover hay and oat straw. In most cases bean meal was also fed and in several cases starch and sugar. The food, urine, and feces were analyzed.

The respiration experiments were made with a Pettenkofer apparatus and by practically the Munich methods and were of 12 hours duration. The carbon, hydrogen, and oxygen balance was not given in the original publication, but the amounts of carbon dioxid and methan produced were measured and the carbon in the food, urine, and feces was determined. The carbon balance was computed by the compilers from the available data and inserted in the table.

The principal conclusions reached were the following: With steers as well as with other animals all the nitrogen excretion is through the urine and feces. When the protein consumed is increased or diminished, there is not an immediate corresponding change in the excretion of nitrogen, but the change is gradual.

When no work is done, a steer requires 500 grams protein per 1,000 pounds (500 kilograms) live weight daily for maintenance under normal conditions.

Increased consumption of water generally increased the metabolism of protein, though this was more noticeable after a few days than at once. The relation between consumed and excreted nitrogen was fairly constant during each experiment. If nitrogen equilibrium was not reached at the first, it was not reached at all.

With steers as with other animals, a marked change in the food produced a marked change in the metabolism of protein, other conditions remaining the same.

The steers produced as much carbon dioxid as sheep, pound for pound. The carbon dioxid production increased when nitrogenous as well as nonnitrogenous food was added to the basal ration. In the author's opinion, the excess of nutrients in a given diet over what is necessary for maintenance can never be as valuable for the production of flesh, etc., as its composition would indicate.

The condition of the animal influences the production of carbon dioxid. Very little methan was found in the gaseous excretory products. It was observed that the excretions of carbon dioxid and water were not always parallel; that each increased (1) when there was less moisture in the air, the temperature remaining constant, and (2) when the temperature increased and the moisture in the air remaining constant. In other words, the respiratory excretion of both carbon dioxid and water increased when the moisture in the air diminished, the temperature remaining constant. When the temperature rose, the moisture content remained unchanged.

Nos. 3476–3499. This series of experiments was made by Kühn, Thomas, Martin, Lankisch, G. König, Mohr, Böttcher, Koch, Waage, Mielcke, Köhler, Lösche, Gerhard, and Kellner at the experiment station in Möckern in 1882, 1885–86, and 1889–90.

[1] Jour. Landw., 1871, p. 27.

The object was to determine whether fat was formed from carbohydrates and under what conditions, and also to study the formation of hydrocarbons in the intestines under various dietary conditions. The experiment was divided into periods. The author's numbers for these periods are given in the table. The subjects were full-grown steers. The respiration apparatus used was of the Pettenkofer type. The capacity of the respiration chamber was 18.21 cubic meters.

No attempt was made in these experiments to measure the water in the respiratory products or outer air. The only determinations made were analyses of food, urine, and feces; the amount of respired air, the carbon dioxid, and marsh gas in it; and the carbon dioxid in the air entering the apparatus. The respired air was measured with a large gas meter. Eight small mercury pumps and 8 small gas meters were used to collect and measure the samples of external and respired air.

It is claimed by the Möckern investigators that their respiration apparatus is extremely accurate in its measurements of respired air and carbon dioxid. The carbon dioxid was measured as in the Pettenkofer apparatus. The respiration chamber contained a manger for food and water, which could be closed air-tight from the outside. Food or water could then be inserted through an opening in the wall, the opening closed and the cover of the manger raised. A correction was always made for the air thus introduced. A similar arrangement was used for collecting the feces. There was a box in the floor which could be closed air-tight and the feces then removed. The urine was collected by means of a "urine funnel" which was strapped on to the animal. The urine ran through a tube passing through the bottom of the chamber and was collected in a large flask. The marsh gas in the respired air was estimated by passing a sample through a combustion tube. Up to 1885 the combustion tube was filled with pumice stone impregnated with platinum and copper oxid. Later kaolin impregnated with platinum was substituted for the pumice stone.

The accuracy of the measurements with this respiration apparatus was tested by control experiments with candles burned in the chamber.

The amount of marsh gas in the atmospheric air was found to be very small and to vary much more than the amount of carbon dioxid. The variation was accounted for by atmospheric conditions, swampy or marshy districts, or, for instance, the presence of large chimneys in the neighborhood.

The conclusions drawn were the following: The smallest ration which will maintain a steer in perfect quiet must furnish 0.7 kilogram digestible protein and 6.7 kilograms digestible nitrogen-free substance per 1,000 kilograms live weight daily. Any excess over this amount of nutrients causes the production of fat. It makes no difference whether the excess be nitrogenous or nonnitrogenous matter. A very valuable practical deduction is that in these experiments even with very wide rations which are not ordinarily regarded as desirable, the intensity of the fat production was in no wise diminished.

Fat is produced from carbohydrates, 1 kilogram of starch producing on an average 0.2 kilogram fat.

Hydrocarbons were always found in the gaseous excretions. The amount was proportional to the total amount of carbon excreted in gaseous form. It was not, however, proportional to the amount of crude fiber consumed. This is contrary to the conclusions drawn by Tappeiner from his investigations. Hydrocarbons (unoxidized carbon) are formed in the stomach and intestines of ruminants not only when cellulose is consumed, but also in about the same proportion when starch or other nonnitrogenous material is substituted for cellulose.

The feeding stuffs rich in protein influence the production of hydrocarbons little or not at all as compared with the other feeding foods.

Nos. 3500–3505 were made by Soxhlet at the Agricultural Experiment Station in Vienna in 1874 and 1875. The object was the investigation of the metabolism of the sucking calf. The experiments were made with 3 steer calves. The food consisted

of milk, which was fed from a bottle. The dry matter, fat, nitrogen, sugar, ash, ash constituents, phosphoric acid, chlorin, and carbon in the milk; the nitrogen, carbon, ash, and ash constituents in the urine; and the dry matter, nitrogen, carbon, ash, ash constituents, and fat in the feces were determined. Respiration experiments were made with a respiration apparatus similar to that of Pettenkofer, and by similar methods. The respiration experiments were of 24 hours duration, and the feeding experiments lasted several days. The experiments are discussed at length in detail.

Among the conclusions reached were the following: A sucking calf closely resembles a carnivorous animal in that its diet consists of animal food with an abundance of protein and fat, the time of digestion is short, and the food is almost completely digested. In the amount of nitrogen and carbon consumed the calf resembles a well-nourished carnivorous animal, and in the quantity of protein metabolized and not excreted, it resembles a fasting carnivorous animal. The sucking calf consumes the same quantity of dry matter, and one and a half times as much protein as a full-grown herbivorous animal of the same weight (sheep) with a very abundant diet, for instance a fattening ration; but it excretes as little protein as an herbivorous animal on a maintenance ration. In the adult animal under all circumstances by far the larger part of the protein of the food is transformed into easily decomposable "circulating protein," but in the calf only a very small part. In an adult animal under all circumstances the protein metabolized is greater than the gain of protein, or, in other words, the larger part of the protein of the food is transformed into circulating protein and the smaller part into protein of tissue. In the sucking calf the reverse is true, since the amount of protein stored is always larger than the amount of protein metabolized, two-thirds of the protein of the food becoming protein of tissue and one-third circulating protein. A very much greater quantity of mineral matter is retained by the sucking calf than by the adult animal.

From the results obtained in these experiments the author computed the food consumed and the metabolic balance for a calf 2 or 3 weeks old weighing 50 kilograms. His results are often referred to, and this calculated average (No. 3505) is usually quoted instead of the results actually obtained.

Nos. 3506–3512 were made by Bidder and Schmidt in Dorpat (?) in 1847–48, in connection with an extended nutrition investigation. The subject was a cat. The food in 5 cases consisted of meat, in 4 cases with, and in 1 without, water. In 2 cases no food was given; water was, however, supplied.

The cat was confined in a metallic box having windows on 3 sides. The capacity of the box was 0.5 cubic meter. The bottom was concave, and in the center there was a tube through which the urine flowed. The nitrogen in the urine was determined by combustion with copper oxid, the urine being first evaporated with powdered quartz. It is not stated that direct determinations of nitrogen, carbon, etc., in the food and feces were made. The inference is that they were, at least in part. No common factor for calculating the nitrogen of meat was used. The cat was allowed to leave the cage some time each day, but was carefully watched.

The respiration experiments were made with an apparatus similar to that of Boussingault. The bell glass under which the cat was placed had a capacity of 39.43 liters. During an hour 15.2 liters of air were passed through the bell jar by means of an aspirator, in order that there might be no accumulation of carbon dioxid, which would hinder the success of the experiment. The air in the room in which the apparatus stood was analyzed.

In these experiments there is a very slight difference between the nitrogen consumed and that excreted. This is explained on the ground that muscular tissue was formed. The possibility of a respiratory excretion of nitrogen is also suggested. [In considering these experiments it is a justifiable assumption that this very small quantity is entirely within the limit of error.]

These experiments are interesting because they were cited by Voit[1] as proving

[1] Ztschr. Biol., 2 (1866), p. 18.

that no nitrogen was excreted except in the urine and feces, while Seegen and Nowak[1] took an opposite view.

Nos. 3513-3515 were made by Bidder and Schmidt in Dorpat (?) in 1849-50, in connection with an extended study of animal nutrition. The subjects were 2 dogs. The food was meat. The food, urine, and feces and gall were analyzed in some cases, and the inference is that this was done for each experiment. The gall was collected by means of a fistula. The respiration experiment was made with an apparatus which is described as being essentially like that of Boussingault.

The carbon dioxid in the respired air was determined. The expired water vapor was evidently calculated.

The conclusion was reached that practically all the nitrogen consumed was excreted in the solid and liquid excretory products.

Nos. 3516-3600 were made by Pettenkofer and Voit at the Physiological Institute in Munich in 1861-1863. The object was the study of metabolism when fasting, and with food furnishing protein, fat, and carbohydrates singly and in various combinations. A dog was used as the subject. Nos. 3525-3532 include the tests while fasting; Nos. 3530-3532 while on a ration of fat; Nos. 3516-3524 and Nos. 3535-3557 on a protein ration; Nos. 3558-3573 on a protein and fat ration; Nos. 3574-3592 on a ration of protein and carbohydrates with and without fat, and Nos. 3593-3600 on a ration of carbohydrates with and without fat.

The experiments lasted several days, though the respiratory products were determined for one day only in each case. The small respiration apparatus devised by Voit on the plan of the large one of Pettenkofer[2] was used.

In these experiments a complete study of the metabolism of nitrogen, carbon, oxygen, and ash was attempted. The food, feces, urine, and ventilating current of air were weighed and measured. In the respiratory products the carbon dioxid and water were determined by absorption and the hydrocarbons and hydrogen by combustion, as in the respiration experiments with men described above.

Lean meat (muscular tissue nearly freed from fat) was used to supply protein, fat pork (?) for fat, and starch or grape sugar for carbohydrates. The meat was carefully selected, cut up into very small pieces, and all visible fat and connective tissue, tendon, etc., removed with pinchers as completely as possible. Voit believed that meat thus prepared was practically unvarying in composition, and that the percentages of nitrogen, carbon, hydrogen, oxygen, and ash might therefore be estimated from previous analyses of similarly prepared lean beef. Accordingly no analyses of the meat were made for these experiments. In like manner the composition of the fat, sugar, and starch was calculated from other analyses. The composition of the feces was likewise estimated, rather than found by actual determination. The urea in the urine was determined by the Liebig titration method. The dry matter in the urine was calculated from previous work.[3] Analyses were also made of samples of the urine which were evaporated to dryness with quartz sand. All the data thus obtained were used in determining the carbon, oxygen, and hydrogen, because it was found that the total dry matter in urine was somewhat greater than the urea plus the soluble salts. What this excess consisted of is not stated.[4]

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[1] Studien über Stoffwechsel, p. 204.

[2] Ann. Chem., Sup. II, p. 1. See also U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 108.

[3] Ztschr. Biol., 1, p. 136.

[4] Ann. Chem., Sup. II, p. 364.

The oxygen consumed was calculated by difference, in the manner shown in the following example:[1]

	Grams.	Grams.
Weight of animal at end of experiment		33, 171.00
Weight of urine excreted during experiment		1, 061.00
Weight of carbon dioxid excreted during experiment		539.40
Weight of water excreted during experiment		343.48
Weight of hydrogen excreted during experiment		0.67
Weight of methan excreted during experiment		2.66
Total		35, 118.13
Weight of animal at beginning of experiment	33, 140	
Weight of food consumed	1, 500	
Total		34, 640.00
Oxygen consumed		478.13

An error of 1 gram in the carbon would make an error of 3 grams in the oxygen, and an error of 1 gram in the hydrogen would make an error of 8 grams in the oxygen. As a control on the accuracy of the calculation of the oxygen, the amount necessary for the combustion of the carbon and hydrogen in the food was also calculated in some cases.

The actual determinations made in these experiments were, therefore, nitrogen, carbon, and hydrogen in urine; dry matter and water in feces; and carbon dioxid, water, methan, and hydrogen in respiratory products.

The principal conclusions drawn from these experiments were the following:

When no food is supplied, the organism lives from the protein and the fat of its tissues, consuming just enough oxygen from the air to oxidize them completely.

When fat alone is supplied in the food and the amount is equal to that consumed from the organism during fasting, fat is consumed from the organism in addition to that supplied by the food. On a diet of fat less oxygen was consumed than during fasting. When larger quantities of fat were supplied, more oxygen was still consumed; and although the organism continued to lose nitrogen, there was a gain of fat.

When lean meat only was fed and the amount eaten was small (500–1,000 grams), the organism lost nitrogen and fat. When a larger amount of lean meat was eaten (1,500 grams), the organism was in nitrogen and carbon equilibrium. When still more lean meat (1,800–2,500 grams) was eaten, more nitrogen was metabolized, but nitrogen equilibrium was eventually reached. Although in this latter case all the nitrogen consumed was excreted (i. e., the nitrogen in urine and feces was equal to that in the food), some carbon was retained by the organism. If carbon is stored in the organism it was assumed that it must be in the form of fat. As the lean meat was assumed to be practically pure protein (only 0.9 per cent being fat), the conclusion was reached that the fat had been formed from protein. The fat thus formed is not proportional to the quantity of meat consumed, but is influenced by the condition of the organism. Thus fat is most readily formed from protein when the body has little fat. The consumption of oxygen increases with the increased consumption of lean meat.

When lean meat and fat are supplied and the amount of fat is not large, the feces contain very little fat, i. e., the fat is assimilated and what is not needed is stored in the organism. If, however, large quantities of fat are eaten, the amount in the feces may be quite considerable, i. e., all the excess over the amount required by the organism can not be absorbed and stored or consumed. If the body has little fat, fat is readily stored up from that taken as fat in the food or from that formed from protein. If there is an abundance of fat in the body it hinders the formation of

[1] Ztschr. Biol., 7, p. 437.

fat from protein. In the opinion of the authors, fat is not more easily burned in the organism than protein, but the reverse. This point is discussed at considerable length.

When lean meat and starch were fed in sufficient quantities, fat was stored in the organism. In the authors' opinion this is not because the fat is formed from carbohydrates, but because the carbohydrates protect the fat which has been formed from protein.

When carbohydrates are taken either alone or with very little fat, all the carbon is excreted and no fat is formed from them. It is immaterial whether starch or grape sugar is used. Less protein is consumed from the tissues than in fasting. The carbohydrates protect the protein.

With starch as food the quantity of feces is very small. With a diet of bread, which is largely starch, the feces are more abundant. Carbohydrates are more easily burned in the organism than fat.

The two important conclusions from all these experiments are that (1) fat is formed from protein, and (2) fat is not formed from carbohydrates.

In view of the importance of the theories deduced from these experiments some statements regarding opinions held to-day concerning them may not be out of place. It is now generally conceded that fat is formed from carbohydrates. This point has been discussed at some length in previous publications of this office.[1]

The formation of fat from protein is perhaps still an open question. Voit's experiments and results have been recently discussed by Pflüger,[2] who advanced objection to them. More recently E. Voit repeated the experiments made by his father with apparently all the needful precautions in the way of analyses, and in a brief preliminary report of his work[3] claims to have substantiated his father's conclusions and to have demonstrated the formation of fat from protein. In E. Voit's experiments the subject was a dog weighing 23 kilograms. Only one experiment is given in detail in the brief preliminary report. The dog consumed daily for 3 days 1,500 grams pure meat (extracted with water), containing 367 grams protein (60 grams nitrogen, 197.4 grams carbon). The nitrogen excreted on the 3 days of the experiment was 35.5 grams, 50 grams, and 53.1 grams, respectively. The protein broken down would furnish 116.7 grams, 161.1 grams, and 174.6 grams carbon; and 129.2 grams, 148.6 grams, and 156.5 grams carbon were actually excreted. On the first day there was a deficit of 12.4 grams carbon, equivalent to 16 grams fat. On the two succeeding days there was a gain of 12.5 and 18.2 grams carbon, respectively, equivalent to 16 and 24 grams fat. The possibility of the stated carbon being in the form of glycogen is also discussed, but the author does not consider it probable.

On the second and third days, therefore, considerable carbon was stored up. It may be that this carbon was stored as glycogen; still, as the author points out, the amount which can be formed from protein is smaller than the quantity of nitrogen-free material which must have been formed in this case.

As pointed out by Zuntz in the article referred to above, the possibility of the formation of fat from protein has been shown by other methods than those of Voit to be extremely probable.

Nos. 3601–3605 were made by Rubner in the laboratory of the Physiological Institute in Munich in 1883. The object was to study the isodynamic values of nutrients for the animal organism. The subjects were dogs. A number of experiments were made besides Nos. 3601–3605, but they could not be included in the present compilation as the data recorded were of a different nature.

No food was consumed. The urine and feces were probably analyzed. The respir-

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[1] N. Zuntz, "The metabolism of nutrients in the animal body and the source of muscular energy" (Experiment Station Record, 7, p. 538). S. Soskin, "The formation of fat in the animal body" (Experiment Station Record, 8, p. 179).

[2] Pflüger's Arch., 51 (1892), p. 267.

[3] Jahresber. Thier. Chem., 1892, p. 34.

atory products were measured and analyzed. In No. 3603 the figures for balance of income and outgo of carbon are not given, as the data were not found in the publication cited.

Among the conclusions reached were the following: Each gram of fat in the food is the isodynamic equivalent of a gram of body fat, and protein of food (circulating protein) is the isodynamic equivalent of protein of tissue which is metabolized when sufficient protein is not supplied in the food. It is probable that the formation of organized protein from the protein of the food takes place without any considerable storing up of potential energy. In general, 240 parts of carbohydrates are the isodynamic equivalent of 100 parts of fat, and 100 parts of protein are the isodynamic equivalent of 113 parts of cane sugar or 122 parts of grape sugar.

In the author's opinion this investigation first gave experimental proof of the fact that energy is utilized in the body without loss; that is, the principle of the conservation of energy holds good for the animal organism.

The experiments and the theories deduced from them are discussed at length.

Nos. 3606, 3607 were made by Simanowsky at the Physiological Institute in Munich in 1883–84. The object was to study the influence on metabolism of a body temperature higher than normal produced by artificial methods. The subject was a dog. No food was consumed. The rise in temperature was produced by giving the dog hot baths of 38–38.5° C. The animal was placed in a large tub which had a wooden cover with an opening for the head. His temperature rose rapidly—for instance, inside of 7 minutes from 38.35° to 40.4°, and remained there until half an hour after the bath. The separation of the feces was made with bones. The urine was collected with a catheter. The nitrogen in the urine was determined by the Schneider-Seegen method and in the feces by the Will-Warrentrapp method.

Respiration experiments were made with the Pettenkofer-Voit apparatus.

The conclusion was reached that raising the body temperature artificially for several hours by means of hot baths did not increase the nitrogen-free metabolic products. The excretion of nitrogen remained normal or was increased a very little.

Nos. 3609–3611 were made by Rubner in the laboratory of the Physiological Institute in Munich in 1883, with a dog. The object was to learn something of the formation of fat from carbohydrates in the animal organism. In one test no food was consumed. In the other two tests the food consisted of cane sugar and starch. The respiration experiments were made with the small Pettenkofer apparatus. In all details this work corresponds to the work of Pettenkofer and Voit.

The conclusion is drawn that fat is formed from carbohydrates in the case of meat-eating animals.

Nos. 3612–3614 were made by Boussingault in 1844 (?). The object was, by comparing the ingested and excreted material, to determine whether nitrogen was excreted in the gaseous excretory products of birds. The subject was a dove. In Nos. 3612 and 3613 the food consisted of millet; in No. 3614 no food was consumed. Elementary analyses of the millet and feces were made. The carbon dioxid produced in the respiratory products was measured by means of a small respiration apparatus. This consisted of a glass bell jar in which the subject was confined, with a suitable device for pumping air through the jar. The carbon dioxid and water in the air which left the jar was determined. In Nos. 3612 and 3613 the subject lost between 1 and 2 grams in weight. More nitrogen was consumed than was excreted in the feces.

It was the author's conclusion that the amount representing the difference was excreted in the gaseous excretory products.

Nos. 3615 and 3616 were made by Kuchein in the laboratory of the Physiological Institute at Munich in 1880. The object was to study the metabolism of fowls when fasting to see if it was similar to that of Carnivora and Herbivora. The subject of No. 3615 was a rooster and of No. 3616 a hen. The rooster died on the ninth day of fasting and the hen on the twelfth day. The nitrogen in the excreta was determined by the Will-Warrentrapp method. The carbon in the excreta was calculated,

The carbon dioxid in the respiratory products was determined with a small Voit respiration apparatus by the usual methods. In No. 3616 the weight of the different organs and the water, nitrogen, and fat in the bones, muscles, tissue, and internal organs was determined.

The following conclusions were reached: When fasting, fowls metabolize less protein and more nitrogen-free extract than other animals pound for pound; therefore the metabolism of fowls can not be regarded as intense. Fowls require much less protein and much more nitrogen-free nutrients for maintenance than other animals of the same weight.

No. 3617 was made by Lehmann, Hagemann, and Zuntz at the Agricultural Experiment Station of the University of Göttingen in 1894 (?), in connection with a series of investigations on the metabolism of a horse, conducted by Zuntz at the Institute for Animal Physiology of the Agricultural Institute in Berlin. The food consisted of oats, hay, and chopped straw, and was calculated to be sufficient for the production of 6,777 kilogrammeters of work. Analyses were made of the food, urine, and feces. The respiratory products were measured for 1 day. An apparatus similar to that of Pettenkofer was used and similar methods followed. The figures for nitrogen in the food, urine, and feces represent the average for several days. In the experiments carried on in Berlin the respiratory quotient was measured by the aid of Zuntz's apparatus—i. e., a tube was inserted in the horse's trachea. This was connected with two tubes and by an arrangement of valves the air passed in through one tube and out through another. No air was taken into the lungs except through this apparatus. It is stated that horses undergo the operation of tracheotomy without permanent injury and apparently suffer no inconvenience from it afterwards. The carbon dioxid produced and oxygen consumed were measured by suitable methods.

The authors devised another apparatus which served the same purpose as the tracheal tube and could be used in place of it. This consisted of a mask worn over the horse's nose and mouth. It was provided with two tubes with suitable valves; one tube for the inspired, and the other for the expired, air.

By combining the results obtained with the Pettenkofer apparatus and those obtained with the Zuntz apparatus it was possible not only to measure the total carbon excreted, but also to determine the amount of carbon dioxid excreted from the lungs and from the intestines and skin.

The following conclusions were drawn from the experiments: Methan accompanies carbon dioxid as a gaseous excretory product of horses, though the amount is very much less than in the case of Herbivora. As an average of six experiments, 210 grams of methan, equivalent to 15.7 grams of carbon dioxid, was produced daily when the horse was fed principally oats, the amount being little more than sufficient for maintenance. The methan is largely excreted from the intestines, and with it about 37.5 per cent of its volume of carbon dioxid. Not more than 1 gram of free hydrogen was excreted per day. In this experiment the horse produced 73.9 liters of carbon dioxid in 24 hours in addition to that excreted from the lungs, and of this 13.3 liters were excreted from the intestines and 60.6 liters through the skin. The gaseous excretion through the skin was about 2.5 per cent of that through the lungs. When the gaseous exchange through the lungs only is taken into account, the carbon dioxid excretion obtained is 3 per cent too low and the nitrogen excretion is also too low, though the amount is less than 3 per cent. Taking into account this error, the metabolism of a horse doing no work, calculated by the Zuntz method, gave the same result as by the Pettenkofer method. The results by the two methods differed only within the limits of error due to the fact that the animal could not be kept perfectly still.

No. 3618 was made by Regnault and Reiset at the College de France in Paris in 1849, and forms part of a long series of respiration experiments. The subject was a rabbit. The food consisted of carrots. No analyses of food, urine, or feces were made. The subject was confined in a small respiration apparatus. This consisted of (1) a respiration chamber, (2) a device for absorbing the carbon dioxid, and (3) a device for supplying oxygen. The respiration chamber was a bell glass of 45 liters

capacity. It was cemented to a base and immersed in water. The carbon dioxid produced by the subject was absorbed in two vessels containing potassium hydroxid solution. These vessels resembled the mercury holders of an air pump. When one was lowered the potassium hydroxid solution would fill it and the other was filled with air from the respiration chamber. When the position of the two vessels was reversed, potassium hydroxid solution passed from one to the other and removed more or less of the carbon dioxid from the air with which it came in contact.

Oxygen was stored in several large vessels and admitted to the respiration chamber as needed. The air in the respiration chamber at the beginning and end of the experiment was analyzed. From the amount of carbon dioxid in it and that absorbed by the potassium hydroxid solution, the amount of carbon dioxid produced was calculated. The nitrogen content of the air at the beginning and end of the experiment was also determined.

In this experiment with the rabbit the air contained more nitrogen than normal air, and the conclusion was reached that nitrogen was excreted in the gaseous excretory products. The rabbit gained 14 grams in weight.

Bidder and Schmidt quoted this experiment in a discussion of the theory of "luxus consumption" of food. They calculated the composition of the food, urine, and feces, and their figures are those given in the table. The figures are quoted for their interest from an historical standpoint.

The authors made a large number of experiments with dogs, rabbits, marmots, chickens, small birds, frogs, and lizards. The marmots were hibernating at the time of the experiment. The special points considered in these experiments were the excretion of carbon dioxid and the amount of oxygen absorbed from the air. The respiratory excretion of nitrogen was also discussed. The authors believed when food was consumed some nitrogen was excreted in the gaseous excretory products, although the amount was very small. When fasting it was believed that nitrogen was absorbed from the air. [The experiment and the respiration apparatus used for it are of special interest, both because of the fact that they mark the beginning of that class of systematic investigations which are commonly classed as respiration experiments, and because of the ingenuity of the apparatus[1] and methods of investigation. Notwithstanding the crudeness of the experimental methods of half a century ago as compared with the present, these investigations have permanent historical value.]

Nos. 3619–3628 were made by Knieriem at the laboratory of the Physiological Institute in Munich in 1879–80. The object was to study the nutritive value of cellulose. Two rabbits were used. They were in separate cages and were fed the same rations. In calculating the results, the mean of the total excreted urine and feces was taken as representing the amounts for one animal. The respiration experiments were made with the small Voit respiration apparatus and were of one or two days' duration. The excreted carbon dioxid was the only factor measured. The food consisted of milk or egg albumen. Horn shavings, crude fiber, and sugar were fed with the milk and meat extract, and horn shavings, sugar, and fiber from cabbage leaf were fed in varying combinations with the albumen.

A sufficient quantity of milk for a whole experiment was boiled, and then kept on ice in sealed bottles until needed. The dry matter, carbon, nitrogen, ash, sulphur, and phosphoric acid in the milk and horn shavings and the fat in the milk were determined. The carbon in the sugar, and crude fiber from cabbage leaf were determined and elementary analyses of egg albumen and meat extract were made. The nitrogen and carbon, and sometimes the sulphur and phosphoric acid in the urine and feces and the crude fiber in the feces, were also determined.

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[1]American readers not familiar with the fact will be interested to know that there is in the laboratory of Professor Chapman, of the Jefferson Medical College, Philadelphia, a duplicate of the famous respiration apparatus of Regnault and Reiset. It was made by Golaz, of Paris, the maker of the original, and from the same drawings.

The conclusion is reached that cellulose is a nutrient for Herbivora. The article contains an extended discussion of the subject, with many references to previous work. A number of digestion experiments in which no metabolic balance was determined were made by the author with man, hens, dogs, a hedgehog, and rabbits.

Nos. 3629–3647 were made by May at the Physiological Institute in Munich in 1892. The object was to investigate metabolism during fever. The subjects were rabbits. Fever was produced by inoculation with hog-cholera culture. In most of the experiments no food was consumed. In some grape sugar and water were injected into the stomach. The urine was collected with a catheter. The respiration experiments were made with the small Voit respiration apparatus. The carbon in the grape sugar was calculated. The nitrogen in the urine was determined by the Kjeldahl or Schneider-Seegen method. The carbon was calculated in two cases from Rubner's figures and in the other cases determined. The carbon dioxid was determined, and in two instances the oxygen was estimated in the respiratory products. Careful records were kept of the body temperature. The heat, measured in calories, produced by the rabbits with and without fever, was calculated.

The principal conclusions drawn were the following: Fever increases the amount of heat produced. This depends upon the fact that more protein is metabolized. Carbohydrates protect protein during fever. The relation of carbon to nitrogen in the urine is changed by fever, fever urine being richer in carbon than normal urine. The increased metabolism of protein during fever is caused by the increased demand of the organism for carbohydrates, which are utilized and can not protect protein.

A number of experiments (which were not of the sort reported in this compilation) were made on the utilization of glycogen during fever. The conclusion was reached that glycogen in the body disappears more rapidly during fever than under normal conditions.

Nos. 3648–3650 and Nos. 3395–3398, Table 36, were made by Henneberg, Busse, Schultz, Kühn, Maercker, Schulze, and Schultze at the experiment station in Weende in 1868, to study the metabolism of sheep on a maintenance ration and to compare the effect of feeding during the day with feeding during the night. The subjects were 2 sheep about 4½ years old. In Nos. 3395 and 3396 the animals were fed during the day and in Nos. 3397 and 3398 they were fed during the night. The food consisted of meadow hay, with a little salt.

No. 3648 is an average, based on Nos. 3395 and 3396, with the figures for balance of income and outgo of carbon in addition. No. 3649 is a similar average, based on Nos. 3397 and 3398. No. 3650 is an average based on 3648 and 3649. The balance of mineral matter given in No. 3398 is an average value for the two subjects for the whole experimental period.

The respiratory products were measured and analyzed in connection with Nos. 3395–3398. Sufficient data were not given by the author to include the results in the present compilation. Analyses were made of the food, urine, and feces. The respiration experiments were made with a Pettenkofer-Voit apparatus by practically the same methods as those followed in Munich. The ammonia in the respired air was also determined. It amounted to 0.37 gram per day, equivalent to 0.31 gram of nitrogen. A test was also made to determine the carbon dioxid excretion when no food was consumed. The urine and feces were not analyzed.

Among the conclusions reached were the following: The carbon dioxid produced during the day and night differed in amount. This was not caused by light and darkness, but by the time of feeding. When the same quantities of food were consumed, the total quantity of carbon dioxid excreted in 24 hours was unchanged.

When food was consumed during the day more carbon dioxid was produced, and vice versa. Variations in the amount of carbon dioxid excreted were also influenced by the fact that the sheep did not remain quiet—by their eating at unusual times, by the temperature of the apparatus, the temperature and quantity of food and water consumed, and by the amount of water vapor excreted through the lungs. The pro-

duction of carbon dioxid and water vapor were parallel. No marked excretion of methan, ammonia, or hydrogen was observed. The inspired oxygen was not all immediately expired. Of the total amount of carbon consumed, 48.7 per cent was excreted in the respiratory products and 43.8 per cent in the feces. Three-fifths of the water consumed was excreted in the urine and feces and two-fifths in the gaseous excretory products. The heat produced by the oxidation processes in the body was calculated to be equal to about 1,900 calories per day, or 420 calories per kilogram body weight.

The experiments and the deductions drawn from them are discussed at length.

No. 3651 was made by Henneberg, Fleischer, and Müller at the experiment station in Weende in 1872, and forms part of an investigation on the changes in metabolism in ruminants due to changes in the food consumed. Two sheep were used as subjects. The excretory products of both sheep were collected and the average results taken as the values for one sheep. The experiments were made by the usual methods followed at Weende.

The investigation was divided into three periods. In the first period the ration consisted of meadow hay and barley meal. In the second and third periods the amount of protein in the ration was increased by diminishing the amount of barley meal and adding wheat gluten. In the publication cited in the reference column of the table the authors reported in full the data for the first period only, but gave conclusions which were drawn from the whole investigation, as follows:

Small animals require relatively more material for building tissue than large animals. In this investigation in all cases where the amount of digestible protein consumed was greater than the amount necessary for equilibrium there was a gain in protein. When this was not the case there was a loss. This was not due alone to the consumption of stored protein, but also and in large part to the great change in the ration. A period of 6 days did not seem to be long enough to insure nitrogen equilibrium.

Nos. 3652–3657 were made by Meissl, Strohmer, and Lorenz at the Experiment Station for Agricultural Chemistry at Vienna in 1882–1884. The object was a study of the metabolism of swine. The food consisted in 2 experiments of rice, in 1 of barley meal, and in 1 of rice, whey, and meat meal. In 2 experiments no food was consumed. Analyses of food and feces were made by the Weende method. The nitrogen in food and feces was determined by the Will-Warrentrapp, Dumas (with Meissl's modification), or Kjeldahl method. Often two methods were used for the same substance. The nitrogen in the urine was determined with Knop's azometer with some later modifications. Carbon was determined in food, urine, and feces. The specific gravity, hippuric acid, and chlorin of the urine were also determined. The carbon dioxid in the respiratory products was determined with a respiration apparatus made on the Pettenkofer plan.

The experiments are discussed in detail, and one of the principal conclusions drawn concerns the very considerable amount of fat which must have been formed from carbohydrates. The digestibility of the rations is also discussed at length. The conclusion is also reached that the amount of protein metabolized increases with the amount supplied in the food.

Nos. 3658, 3659, and 3453, Table 37, were made by Kornauth and Arche at the Imperial Agricultural Chemical Experiment Station in Vienna in 1889. The object was to study the metabolism of swine on a diet containing corn cockles.

In Nos. 3453 and 3658 the food consisted of corn cockles, barley, and maize, and in No. 3659 of oil cake, barley, and maize. A little salt or salt and calcium phosphate were fed with the grain. Full analyses of food and feces, including total nitrogen and amid nitrogen, were made. The carbon and nitrogen in the urine were determined in Nos. 3658 and 3659, and the carbon dioxid in the respiratory products was determined with a Voit respiration apparatus.

Two other pigs were fed for purposes of comparison. One received the same ration as in the experiments proper, the other a ration consisting of 70 per cent corn

cockles and 30 per cent barley and maize. The results were not given in such form that they could be included in the present compilation.

The following conclusions were reached: Corn cockles diminished the metabolism of protein, increased the accumulation of fat, and diminished the excretion of carbon dioxid. They produced no bad effects on the health of the pig. When the ration was largely composed of corn cockles it was not eaten as readily, owing to its bitter taste, and the pig made little growth.

The digestibility of the ration with corn cockles did not differ materially from that of the ration without them, and the flesh gained on the ration containing them was normal in quality and composition. Considering their small cost, corn cockles may be regarded as a suitable food for pigs.

An investigation of the possibility of the formation of fat from protein in a cat was reported by Cremer[1] too late for insertion in the tables of this compilation. A considerable number of experiments were made at the University of Vienna. The article cited is a brief report of some of them. The urine was collected as in Bidder and Schmidt's experiments, and analyses were made of the food, urine, feces, and gaseous excretory products, a respiration apparatus being employed for the measurement of the respired air. After a daily consumption of 450 grams of meat for 8 days the subject fasted. The daily excretion of nitrogen (average of 8 days) in the urine and feces was 13.0 grams. The excretion of carbon in the urine was 7.5 grams, in the feces 1.4 grams, and in the respiratory products 25.4 grams; in all, 34.3 grams. The total carbon which it was calculated would be furnished by the metabolism of protein sufficient to furnish the nitrogen excreted was 41.6 grams; that is, the body gained 7.3 grams carbon, which must have been derived from the cleavage of protein of body tissue. In the calculation it was assumed that in fat- and glycogen-free flesh nitrogen is to carbon as 1:3.2. The calculated gain of carbon for the whole period (8 days) was 58 grams, which would be equivalent to about 130 grams of glycogen. At the close of the experiments the cat was killed. It weighed 3.7 kilograms, and the organs and tissues were found to contain only 35 grams of glycogen and sugar.

Experiments were also made with a cat fed an abundance of meat. It was calculated that in one of the experiments over 20 per cent of the total carbon derived from metabolized protein was stored up in the body. The nitrogen excretion reached 5 grams per kilogram of body weight—a very high value.

The author concludes that his experiments confirm Voit's theory of the formation of fat from protein.

Experiments, received too late for insertion in the tables of this compilation, were made with two steers A and B at the Agricultural Experiment Station at Möckern by Kellner, Köhler, Barnstein, Zielstorff, Hartung, and Lührig.[2] The object was to study the metabolism of matter and energy on a maintenance ration. This work is regarded by the authors as preliminary to a series of investigations on the metabolism of steers under various conditions. The food, urine, feces, and respiratory products were analyzed. The respiratory products were measured by the Pettenkofer apparatus. The analytical methods and apparatus were the same as those used by Kühn[3] in his experiment with steers. For some time before the experiments proper began the steers were fed the same ration under similar conditions, to accustom them to it. The digestibility of the ration was determined for 15 days. Five of the days (not consecutive) were spent in the respiration apparatus.

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[1] München. med. Wochenschr., 44 (1897), p. 811.

[2] Landw. Vers. Stat., 47 (1896), p. 275 (Experiment Station Record, 9, p. 167).

[3] Landw. Vers. Stat., 44 (1894), p. 257.

The daily balance of income and outgo of nitrogen and carbon was as follows:

Balance of income and outgo of nitrogen and carbon.

	Nitrogen.				Carbon.				
	In food.	In urine.	In feces.	Gain (+) or loss (—).	In food.	In urine.	In feces.	In respiratory products.	Gain (+) or loss (—).
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Steer A: 8.5 kg. hay, 26 kg. water	116.2	61.3	48.7	+ 6.2	3,554.6	210.4	1 207.0	1,810.0	+ 127.2
Steer B: 4 kg. hay, 5 kg. straw, 40 gm. salt, 2,621 kg. water	77.1	46.6	45.1	—14.6	3,554.2	169.1	1,500.1	2,011.6	—126.6

From the balance of nitrogen and carbon the authors calculate that steer A gained 39 grams protein and 139 grams fat, and that steer B lost 91 grams protein and 102 grams fat. The fuel value of the food, urine, and feces was determined by the bomb calorimeter.

Taking into account the fuel value of food and excretory products, and of the gain or loss of body tissue, the balance of income and outgo of energy in the two experiments was determined. (The balance is not complete, since the author did not measure the energy liberated as heat or used for external muscular work.) The fuel value of these factors was as follows:

Fuel value of food actually consumed, excretory products, and tissue gained and lost in experiments with steers.

	Income.	Outgo.
	Calories.	*Calories.*
Steer A:		
Meadow hay (7,263 gm.)	32,177.3	
Feces (2,547 gm.)		11,750.3
Urine, dry matter (633.7 gm.)		1,945.0
Methan (158.4 gm.)		2,098.2
Protein tissue gained (39 gm.)		220.5
Fatty tissue gained (139 gm.)		1,320.5
Total outgo and stored material		17,334.5
Balance	14,842.8	
Steer B:		
Meadow hay (3,494 gm.)	15,426.4	
Oat straw (4,146 gm.)	18,368.0	
Feces (3,086 gm.)		14,576.1
Urine, dry matter (542.5 gm.)		1,549.4
Methan (174.7 gm.)		2,314.1
Protein tissue from body	405.3	
Fatty tissue from body	969.0	
Total outgo		18,439.6
Balance	16,729.1	

From their own experiments, and from experiments by Kühn, the authors calculate that for steers 24,000 calories of energy per day per 1,000 kilograms live weight are necessary for maintenance, and that the nutritive ingredients of hay of fair quality and similar feeding stuffs furnish about 3.5 calories per gram.

EXPERIMENTS IN WHICH THE BALANCE OF NITROGEN AND ENERGY WAS DETERMINED.

The establishing of the balance of energy in the animal body is a difficult task, since it involves the determination of the income and outgo of nitrogen, carbon, and other elements and adds thereto the measurement of the potential energy of food and excretory products and the more serious problem of measuring the energy transformed within the body and given off as heat, mechanical work, or otherwise. This balance may be most conveniently expressed in terms of heat. The fuel value of the food consumed and of the urine and feces may be easily determined by a bomb calorimeter,[1] or some similar suitable instrument.

The measurement of the heat radiated from the body requires special apparatus to which the name respiration calorimeter has been applied. Several forms have been devised. A description of these, reasonably complete up to date of publication, was prepared several years ago, by Rosenthal (see p. 12). Most of the calorimeter experiments which have been found in the literature of the subject have been concerned with the measurement of the energy produced by the subject. The energy of the food has been left out of account, not because it was unimportant, but because the elaboration of methods and apparatus for the special point studied was necessary before more complex investigations could be undertaken. No published experiments have been found with man in which the balance of income and outgo of energy was determined. A considerable number were made by Likhachev[2] at St. Petersburg in which the attempt was made to measure the total outgo of energy with a calorimeter of special construction. This was a development of the apparatus used by Pashutin[3] in similar experiments with animals. As stated in a previous publication[4] of this Office a respiration calorimeter designed for experiments with man has been constructed in this country, although the experiments in which the balance of income and outgo of energy was determined have not been published.

EXPERIMENTS WITH ANIMALS.

In Table 39 are included 9 tests with dogs in which the balance of nitrogen and energy was determined. These experiments and others in which the results are not tabulated are discussed in the text.

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[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 120.

[2] The production of heat by healthy man in a condition of comparative rest. Inaug. Diss. (Russian), St. Petersburg.

[3] Vrach, 1886, No. 18.

[4] U. S. Dept. Agr., Office of Experiment Stations Bul. 44.

TABLE 39.—*Experiments with dogs in which the income and outgo of nitrogen and energy were determined.*

Serial number.	Date of publication.	Observer.	Subject.		Food per day.	Duration.	Nitrogen.				Energy.			Remarks.
			Kind of animal.	Weight.			In food.	In urine.	In feces.	Gain (+) or loss (—).	Fuel value of food and body tissue consumed.	Heat produced measured by calorimeter.	Difference.	
				Kg.		*Days.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Calories.*	*Calories.*	*Calories.*	
3660	1894	Rubner	Dog	4.6	Fasting	5	0.0	1.4		—1.4	259.3	261.0	— 1.7	
3661	1894	....do	Dog	12.0	....do	2	0.0	3.5		—3.5	545.6	528.3	+17.3	
3662	1894	....do	Dog	4.4	....do	1	0.0	1.1		—1.1	243.5	257.1	—13.6	Last day of No. 3660.
3663	1894	....do	....do	4.4	390 gm. meat	1	13.3	8.5		+4.8	329.9	333.9	— 4.0	
3664	1894	....do	....do	5.0	40 gm. fat (bacon)	5	0.0	1.3		—1.3	302.0	299.1	+ 2.9	
3665	1894	....do	....do	5.0	80 gm. meat; 30 gm. fat (bacon).	12	2.7	2.6		+0.1	332.1	329.9	+ 2.2	
3666	1894	....do	....do	4.8	....do	8	2.7	3.0		—0.3	311.6	311.0	+ 0.6	
3667	1894	....do	....do	4.9	350 gm. meat	6	11.9	10.1		+1.8	375.0	379.5	— 4.5	
3668	1894	....do	Dog	11.8	580 gm. meat	7	19.7	18.5		+1.2	683.0	681.3	— 1.7	

Nos. 3660, 3661. Ztschr. Biol., 30, p. 119. Nos. 3662, 3663. Ibid., p. 122. No. 3664. Ibid., p. 124. No. 3665. Ibid., p. 127. No. 3666. Ibid., p. 129. No. 3667. Ibid., p. 132. No. 3668. Ibid., p. 134.

Nos. 3660–3668 were made by Rubner at the University of Marburg in 1889–90 as a study of the source of animal heat. The subjects were two dogs, weighing about 5 and 12 kilograms, respectively. In some of the experiments the animals fasted; in others they had lean meat to furnish protein, or bacon to furnish fat, or both. They were placed inside the chamber of a respiration calorimeter especially devised by Rubner for determining the respiratory products and the heat given off from the body.[1] The respiratory products were measured by the methods of Pettenkofer and Voit, and the heat by the expansion of air. The respiration chamber was a box with 6 rectangular walls of copper. This was surrounded by a box of copper, making an air jacket, and this in turn by another copper box making a second air jacket which served to isolate the air in the inner jacket from an outer jacket of water contained in a double-walled box of copper surrounding the whole. The inner air jacket was connected by a tube with a spirometer which served to measure the expansion of the air in the jacket when the latter was heated or the contraction when it was cooled, thus making practically an air thermometer. The water in the outside jacket could be maintained uniformly at any convenient temperature. It served not only to prevent access of heat to the chamber from without but also to absorb and carry away heat which was given off within the chamber and passed through the air jackets. Inside the water were vessels of copper connected by a tube with a second spirometer, making a second air thermometer which showed the corrections to be applied for temperature and barometric pressure. At one end was an opening through the walls of the apparatus. This was closed by a cover consisting of a metal frame with a double window of glass. By opening this door the animal could be passed in and out. Tubes were also provided for passing a current of air through the chamber and for mercury thermometers. A part of the heat given off from the body of the animal was carried out by the air current and was determined from the volume of the latter and its rise in temperature in passing through the chamber; another part was carried away in the water vapor in this air, which was also measured, while the greater part passed through the walls the amount being determined from the expansion of the air in the inner jacket. The mechanical features of the apparatus were numerous. Its accuracy was tested by numerous control experiments in which known amounts of carbon dioxid, water, and heat were introduced into the chamber and measured.

In the experiments with animals the determinations actually made were as follows: The weights of the animal at the beginning and at the end of the experiment, of food and water given, and of urine and feces; the percentages of fat in the food and of nitrogen and feces in the urine; the weights of carbon dioxid and water in respiratory products; and the calories of heat given off from the body. The nitrogen in the food (lean meat) was computed by the compilers for the nitrogen balance in tabulating the results, Voit's factor (3.4 per cent), which is assumed by the author in discussing the experiments, being used for the computation. The carbon was not determined in the food, feces, or urine and no carbon balance was made. No determinations were made of heats of combustion of food or excretory products.

For the balance of energy the income was estimated by the author from the estimated amounts of material oxidized in the body, and the outgo was found in the measurement of the heat given off from the body as above described. The materials oxidized were assumed to be protein, fats, and carbohydrates of the body or the food, or both. The amounts were estimated from the nitrogen and carbon excreted in the urine and the carbon dioxid exhaled. From the nitrogen excreted the amount of protein oxidized and the carbon in the latter were computed. The remaining carbon was assumed to come from fat and carbohydrates burned. How much belonged to each of these two latter classes of compounds the data of income and outgo of material were insufficient to show, but the author assumes that the proportions can be calculated from the amount of heat produced. The data for the bal-

[1] Described by Rubner in Calorimetrische Methodik. Marburg, Elwert, 1891.

ance of energy given in the tables were estimated by the author. The differences of income and outgo of energy in the individual days and experiments as thus computed were in some cases quite appreciable, but for the forty-five days covered by the experiments there was a discrepancy of only 0.47 per cent. It is assumed that all of the energy given off from the body of the animals was in the form of heat.

In the author's opinion these experiments furnish a proof that the nutrients of the food and the body materials consumed are the sole sources of heat in the animal body. They thus confirm the belief that the law of the conservation of energy applies in the living organism.

The experiments are discussed at considerable length, and from standpoints different from that of the present compilation.

In a bibliography of Russian literature received from Russia too late for detailed use in this compilation reference is made to the following investigations in which calorimetric measurements were made in connection with investigations of the respiratory quotient. With one exception these were published as inaugural dissertations at the Imperial Military Medical Academy of St. Petersburg. In the last three experiments cited the balance of income and outgo of nitrogen was also determined, and a "water calorimeter" was used for the measurement of heat. Pashutin's apparatus was generally used for the determination of the respiratory quotient.

In 1884 Kostiurin published the results of experiments on the effect of injuring the lower part of the spinal cord upon metabolism in animals. Three experiments of from two to six days' duration were made with fasting dogs. The conclusion was reached that the amount of heat produced and the carbon dioxid excreted was increased, and at the same time the ratio of heat to carbon dioxid production was increased.

In the same year Botcharov published a report of his experiments on the influence of septic poisoning on metabolism. Twelve experiments of three days' duration were made with fasting dogs. Poisoning was produced by the injection of a fermenting solution (*Jauche*). In the author's opinion this form of poisoning increased the production of carbon dioxid, water vapor, and heat.

In 1886 Sadovyen published an account of investigations on the respiratory quotient and the production of heat in uræmia. Fourteen experiments of from four to seven days' duration were made with dogs and rabbits. The ureter was ligated. The conclusion was reached that in uræmia there was a decrease in the consumption of oxygen and the production of carbon dioxid, water vapor, and heat.

Jurovski published in 1888 the results of experiments on the respiratory quotient and the production of heat in poisoning produced by gallic acid salts. Fifteen experiments of from four to six days' duration were made with rabbits. It was found that the amount of oxygen consumed and the carbon dioxid and heat produced was decreased.

In the same year Kosorotov published an account of experiments on the effect of poisoning due to putrescent material. Twenty experiments, continuing from twelve to twenty-four hours, were made with fasting dogs. Calorimetric measurements were made in only fourteen of the experiments. The author found that the amount of oxygen consumed and carbon dioxid and heat produced increased after the injection of Naegeli's solution, which had putrefied on exposure to the air.

In 1890 Archarov[1] published an article on the relation of antipyretics to fever. Forty tests of six hours' duration were made with dogs. Fever was induced by the injection of Naegeli's solution (*Nägelischer Jauche*). The conclusion was reached that under the influence of quinin and antipyrin the oxidation processes of the body and the production of heat increased. When fever was induced and antipyretics were given the increase was still greater.

In the experiments which follow the nitrogen balance was determined in addition to the respiratory quotient and calorimetric measurements.

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[1] Voyenno Med. Jour. [St. Petersburg], 1890, Apr.

Uschinski published in 1891 the results of investigations of the respiratory quotient and the production of heat in glycoseria induced by phlorizin. Eight tests of five days' duration were made with dogs fasting and fed under various conditions. The author believes that in glycoseria it is possible that the kidneys are an important factor. It is hardly probable that the amount of heat produced can be accurately calculated from the amount of matter metabolized in the body.

In 1893 Likhachev investigated the production of heat by healthy man in a condition of comparative rest. Six experiments were made, each continuing twenty-four hours. The principal conclusions reached were the following: In healthy man the daily production of heat is from 33.0 to 38.7 calories per kilogram body weight, and when fasting 31.8 calories. At night during sleep the heat production and liberation and the respiratory quotient decreased. Soon after falling asleep the decrease in the production and liberation of heat was more pronounced than the decrease in the respiratory quotient. The author believes there is a parallelism between the production of carbon dioxid and the liberation of heat dependent upon the fact that both processes are regulated by a common cause.

In 1897 Studenski published the results of an extended investigation for the purpose of comparing the amount of heat actually produced by the body with the calculated amount (using Rubner's figures). Forty-five tests of twenty-four hours' duration were made with dogs fasting and fed with meat. Some of the dogs were in normal condition and others were pregnant or had fever. In the case of healthy dogs Rubner's method of calculating thermal values gave results which were practically identical with the measurements of the heat actually produced per day. In the case of dogs with fever the heat actually produced in a given time was less than the calculated amount which the matter metabolized during the same period of time would furnish. Relatively less oxygen was consumed during fever than under normal conditions.

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